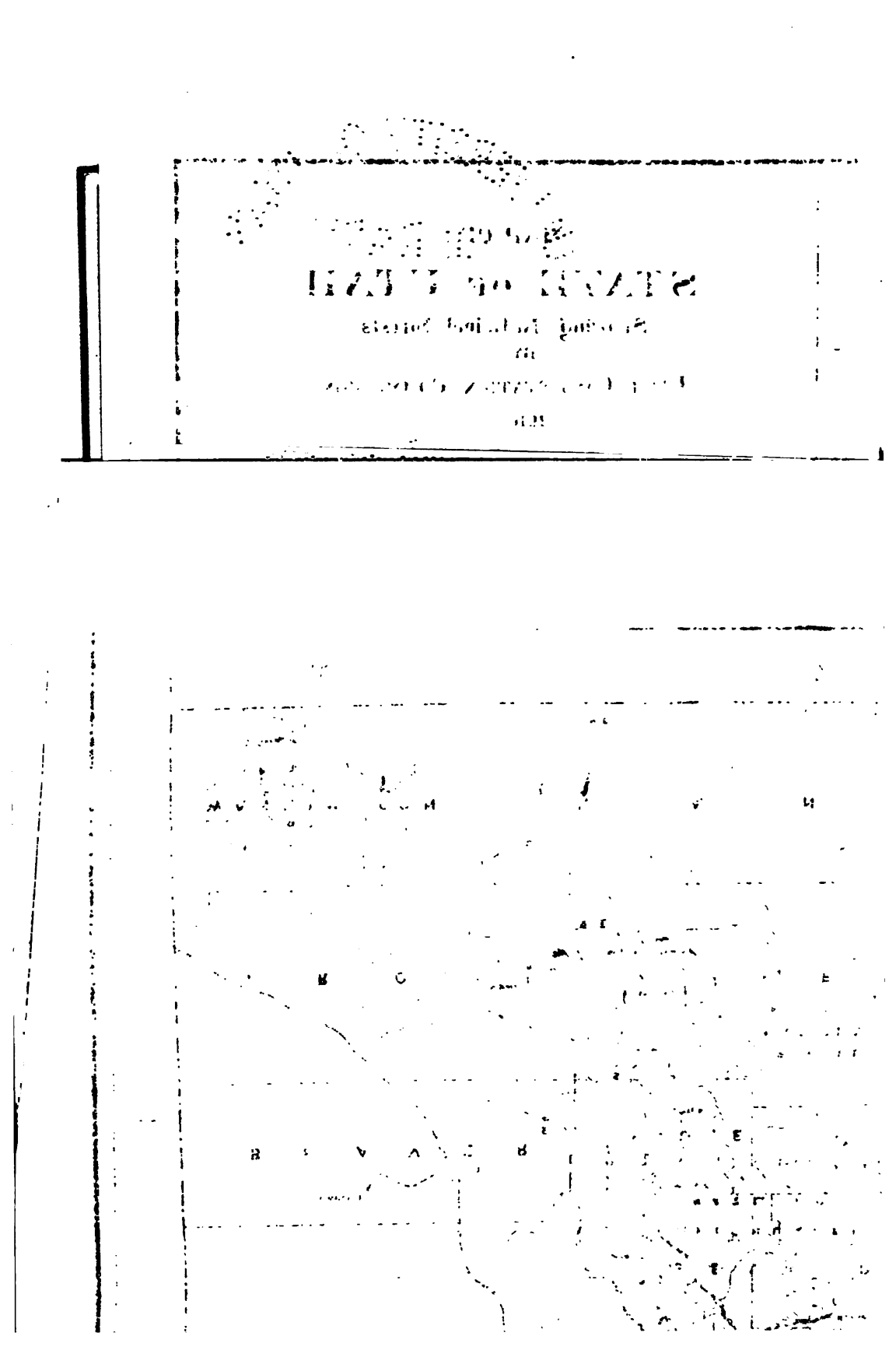
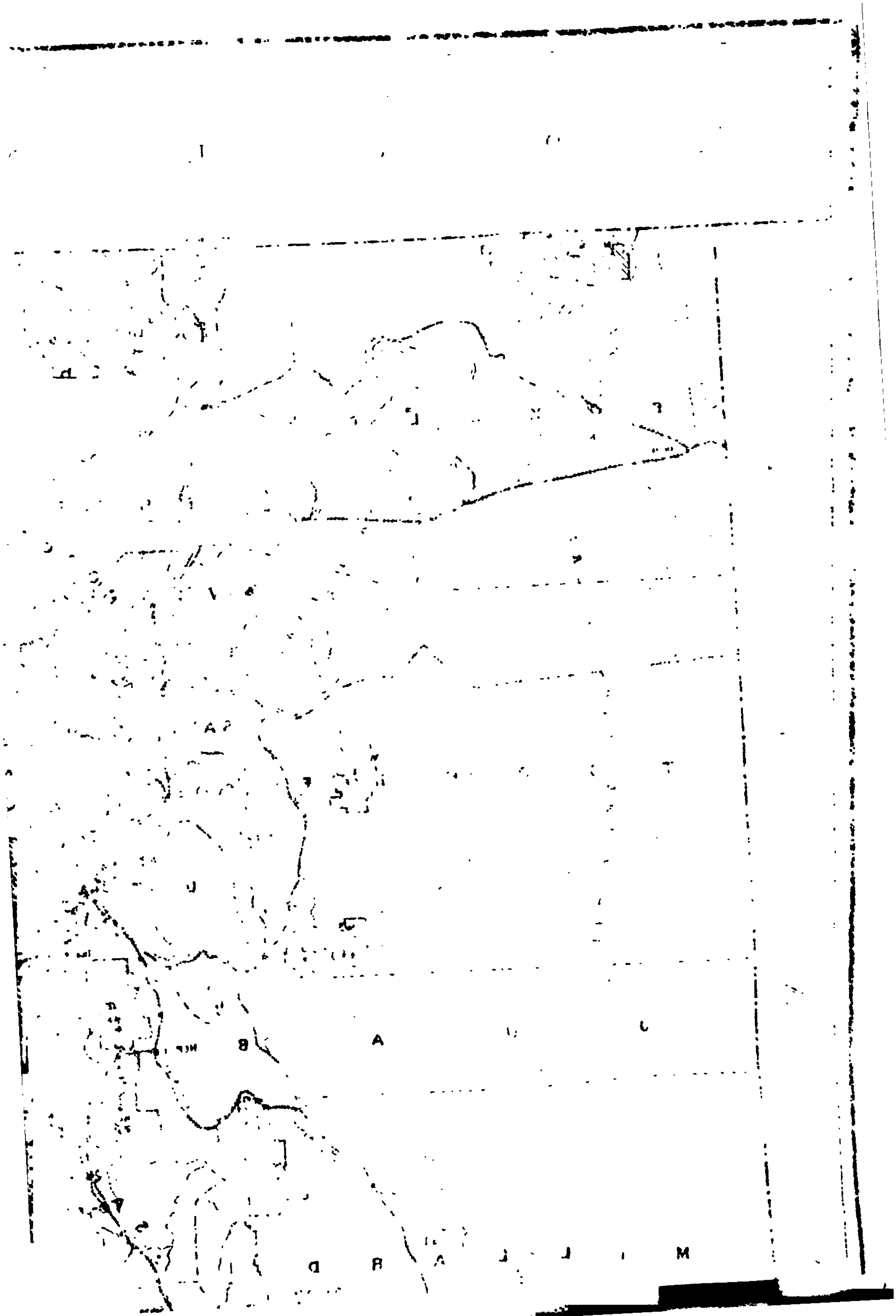
Preliminary Report

Utah
Conservation Commission
1909

Utah — Conservation






SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
FIAT LVX
MDCCCLXVIII
EX LIBRIS

Preliminary Report

OF THE

UTAH CONSERVATION COMMISSION

1909

SALT LAKE
1909

Word of Governor Spry.

THE wanton waste of our national resources; the improvident drafts on Nature's store-houses, carried on for these many years by the voracious few and countenanced by the thoughtless many, have at last been forcibly brought to the attention of the American people. Condemnation of this waste has found utterance in every section of the country, and scientific remedial measures are being developed in the great National and State Conservation movements inaugurated during the administration of President Roosevelt.

Rich with the gifts of Nature beyond any other section of the country, Utah should be deeply interested in these movements. Fortunately the ruthless hand of the public resource pillager has rested lightly on our State, and restoration is less a problem than conservation.

The Utah State Conservation Commission is engaged in the task of making an inventory of the state's resources, developed and unde-

veloped, and issuing a report which shall establish a sure and substantial foundation for economically drawing on our natural resources for the needs of the present generation, and husbanding them for the needs of future generations. The labor such a report involves is great, and I earnestly urge all State, County and City Officials, and the people of Utah generally to co-operate with and support these public spirited gentlemen in the work which they have undertaken.

WILLIAM SPRY,
Governor of Utah.

Submitted

To His Excellency, William Spry,

Governor of Utah.

Sir: We, the members of the Utah Conservation Commission, have the honor to submit the following preliminary report. It is always more difficult to make a beginning than to proceed later. We have tried to present a statement of present conditions, with some comments, and such suggestions as have been tendered with a purpose of getting the largest possible measure of utility from these resources for the people of Utah—now and for all time. And while we cheerfully concede some of the imperfections to this report, we take the liberty to express the belief that later numbers will more completely answer the demands of the time.

Permit us, in this connection, to acknowledge our obligation to Mr. J. E. Pettit, State Coal Mine Inspector; Mr. Fred W. Chambers, fish and game warden; Mr. Clyde Leavitt, District Forrester; Mr. Willard Hansen, state dairy and food commissioner, and other state and government officials, whose assistance in contributing data has been invaluable.

We have the honor to remain,

THE UTAH CONSERVATION COMMISSION.

UTAH STATE CONSERVATION COMMISSION.

GOVERNOR WILLIAM SPRY, Chairman.

O. J. SALISBURY, Vice-Chairman.
Felt Building, Salt Lake

JOSEPH F. MERRILL, Secretary
University of Utah, Salt Lake.

JOHN A. WIDTSOE, Agricultural College, Logan.

THOMAS L. ALLEN, Coalville.

GEORGE AUSTIN, Salt Lake.

LEROY ARMSTRONG, Salt Lake.

B. B. MANN, Clerk, Salt Lake.

Charter One Hundred and Three

The following law, enacted by the Legislature of Utah in 1909, is the charter under which the Utah Conservation Commission operates:

SECTION ONE. That a commission to be known as the Utah State Conservation Commission is hereby created, to consist of not less than three members, citizens of the State of Utah over the age of 21 years.

SECTION TWO. That the Governor of the State of Utah shall be ex-offiicio a member and chairman of said commission, which shall serve for a term of four years without compensation.

SECTION THREE. That it shall be the duty of said commission to adopt and carry out such policies and measures as will prevent waste of the natural resources of Utah and to co-operate with the National Conservation Commission and with the conservation commissions of other states in any way that shall have for its object the conservation of the natural resources of Utah.

The Act further provides that the commission is to:

1. Collect and publish statistics and data relative to the natural resources of the State of Utah.

2. To place before the legislative and executive departments of the United States, including the National Reclamation Service, data and facts showing the great value of the arid lands in Utah when subjected to irrigation, and facts and information for the guidance of the legislative and executive departments of the United States in establishing dams, reservoirs and irrigation systems for the reclamation of arid land in the State of Utah.

3. To aid the Forestry department of the United States in the protection of the timber lands and water sheds in the State of Utah, and also to procure equitable privileges to the users of national forest reserves in the State of Utah.

"WASTE NOT, WANT NOT."

The purpose of the Utah Conservation Commission, in the present paper, is to present a preliminary report, a record of so much of the work as has been accomplished along untried ways, and to lay the foundation for a more complete and more helpful paper later on.

It has been the aim of the Commission to find exactly what are the natural resources of Utah in soil, in minerals, in water and in wood; to find if either of these resources has been wasted by the people, either through lack of knowing how best to conserve them, or for any other reason; and to point out how much more rich and fortunate the people would be if the waste were eliminated, and all the resources employed.

Both in this preliminary report and in the future activities of the Commission it is the purpose to suggest the reforms that should be adopted, the laws that should be enacted by the legislature of the state; to more actively and effectively co-operate with such agencies as have been established by the state of Utah, looking to the conserving and utilizing of all the resources of the state.

It is also the purpose of the Commission to work in perfect harmony and large effectiveness with the National Conservation Commission, and with the Commissions of other states—to the end that the general cause may be promoted in the country at large, as well as in the state of Utah.

For it is the conviction of this Commission that the old adage is true, and that if the people waste nothing of their resources, they will never in the future want for anything.

Utah Conservation Commission

OUTLINE OF THE BEGINNING AND PROGRESS OF THE NATIONAL CONSERVATION POLICY.

Comparison of the natural resources of the present with the natural resources of fifty years ago is so significant and the rate of waste so great that it strikes at the very foundation of national prosperity and threatens it with destruction.

The realization of these conditions and the importance of this question brought about what has become known as the Conference of Governors, called by President Roosevelt at Washington, May 13 to 15, 1908, and attended by the Governors of the States and Territories, as well as by the Senators and Representatives of the Sixtieth Congress, and by a large number of representatives of various scientific and economic associations and organizations.

FIRST MEETING TO CONSIDER CONSERVATION.

This conference was the first step taken toward the recognition of the urgent necessity for a National Conservation policy; and so vital is the importance of this movement to conserve the natural resources of our country that for the first time in the history of our government the Chief Executive officers of the States separately, and of the States together forming the nation, were assembled to consider it.

The result, in brief, of the Conference of Governors was the arousing throughout the country of thought and general interest in the need for proper use of our natural resources, and the recommendation by this conference for the appointment by each State of a Commission on the Conservation of Natural Resources to co-operate with each other and with any similar commission of the Federal Government; also, a recommendation for the creation of a National Conservation Commission.

Acting on the suggestions of the Conference of Governors, on June 8, 1908, President Roosevelt appointed a National Conservation Commission, with Gifford Pinchot as Chairman.

JOINT CONFERENCE AT WASHINGTON.

On December 1-7, 1908, at Washington, a Joint Conference on Conservation between the Governors of States, the State and National Commissions and representatives of national associations was held, the object being to confer on an inventory of the national resources, prepared by the National Conservation Commission, and to discuss means and methods for promoting the work of conservation.

At this Conference the report of the committee on organization was approved, one of the principal points of this report providing for the appointment of a joint committee on conservation with Gifford Pinchot as Chairman, and Thomas R. Shipp as Secretary, which should act as a medium of cooperation or clearing house through which the various State Conservation commissions and conservation organizations could be kept in touch, each with the other and with the National Conservation Commission, and to act in a capacity of suggesting plans for operation of the various state commissions.

The first National Conservation Congress was held at Seattle, August 26-29, 1909, the official report of which has not as yet been made.

CONSERVATION AS APPLIED TO UTAH.

Creation of Utah State Conservation Commission:

Conservation bill as passed by the Legislature;

Aims of the Utah State Conservation commission;

Need for co-operation from every department of the state, and every individual throughout the state;

The returns which will follow the adoption of legislation for the proper use of the resources of Utah;

The need for general thought and study of conservation policies by the people of Utah, in order that the subject may be intelligently dealt with in commercial and industrial enterprises, and in securing proper legislation pertaining to same.

LAND

Agricultural Resources of Utah

INTRODUCTION.

Utah's claim that she must of necessity become one of the great commonwealths of the country rests primarily upon her surpassingly great agricultural resources. Utah is a young state, scarcely yet conscious of her boundless natural resources. Her soils have scarcely been touched; the limits of production on these soils are not half understood and the crops which, commercially, will make of Utah one of the great agricultural states of the Union are just beginning to be cultivated. The period of pioneer life during which were laid secure foundations for membership in the sisterhood of states, required, the founders of the State to confine themselves largly, to the more elementary practices of agriculture. This preliminary period in the State's growth has now been passed, and Utah is entering upon its period of great agricultural development.

AREA.

Utah covers an area of 54,300,000 acres. Of these, about twenty millions consists of mountains and lakes, and approximately twelve million acres are coal, salt and similar lands. The remaining twenty-two millions are all subject to agricultural cultivation. Of this vast agricultural area less than one-tenth is cultivated at the present time. This fact, alone, shows the great possibility for agricultural development.

CLIMATE.

The agriculture of Utah is determined by the prevailing climatic conditions. The average annual rainfall over the State varies from twelve to fifteen inches. In some places it rises to eighteen and twenty inches, and on the deserts it frequently falls to five inches. The distribution of this rain-

fall is very favorable for the production of crops, for most of it falls during the winter and early spring months when evaporation is low, while the summers are practically rainless. The evaporation of water within the State goes on very rapidly, for the humidity of the air is very low, the sunshine is abundant and the average temperature is above the average for the United States. While the somewhat low rainfall is easily dissipated by the dry air and abundant sunshine, yet these latter factors have an important bearing upon the fitness of Utah as a habitation for a prosperous people. The dry air gives comfort in the hot season and is health producing, and the abundant sunshine impresses its cheer upon the State's character. Over a great portion of the State, the winter precipitation comes in the form of snow, giving ideal, dry and moderately cold winters. Early and late frosts are not of frequent occurrence, though fruit growers have to count on them in occasional years.

AVERAGE RAINFALL, TEMPERATURE AND RELATIVE HUMIDITY FOR THE STATE OF UTAH FOR 1908.

	Average Rainfall	Average Temperature (Fahrenheit)	Average Relative Humidity for Salt Lake City, 1909. (Per cents)
January	0.79	27.8	63
February	1.16	31.2	62
March	1.10	39.8	58
April	0.49	49.4	47
May	2.35	50.7	45
June	1.09	59.6	36
July	0.96	71.5	36
August	1.20	68.1	45
September	1.87	59.3	50
October	2.22	44.8	43
November	0.62	36.0	65
December	0.97	25.4	81

SOILS.

The soils of Utah are intimately connected with the early geological history of the West. The western half of the State lies within the Great Basin. Most of the eastern half forms the high plateaus of Utah and partakes very much of the character of the soils of northern Arizona and eastern Colorado. The northeastern corner of the State is filled with high mountains covered with trees and nutritious grasses. In the Great Basin section of the State, the soils have been formed by the action of the prehistoric Lake Bonneville, which formerly covered the whole of what is now known as the Great Basin. The washings from the mountains were carried down into the lake by the rivers and distributed over the lake bottom to form the soils of the present day. These soils are of unusual depth and fertility. Their lower layers, to a depth of forty and fifty feet are almost as fertile as the surface soils. The soils covering the eastern half of the State, known as the high plateau soils, were formed in early geological days when a shallow ocean covered that portion of the State. From the manner of their formation they are also of remarkable depth and fertility. Like the Great Basin soils, their subsoils are practically as fertile as the top soils. In the mountainous regions the small valley are filled with washings from the mountains forming soils of high fertility. The fact that the rainfall is not sufficient to drain through the soils to wash out the fertiliy, has conserved for untold ages the store of plant food. All in all, Utah soils are of unsurpassed fertility. Every landowner within the State owns virtually not one, but several farms, because of the equal fertility of the layers of the soils to very great depths which is drawn upon by the deep-going plant roots.

However, even with this high fertility, the conservation of Utah soils needs to be carefully considered. Improper methods of irrigation and continuous cropping with exhaustive crops will tend to diminish the native fertility of the soil. On the other hand, scientific investigation has already demonstrated that by proper methods of tillage the fertility of Utah soils may be maintained indefinitely so that the time

need never come when we shall have to deal with the question of exhausted soils which is now the most vital question in Europe and many of the older sections of the country. The conservation movement can probably do no greater service to this State than to make possible an extensive study of the present soil resources of the State of Utah and a determination of the methods whereby the fertility of the soil may be conserved indefinitely.

WATER SUPPLY.

As already indicated, the water supply of the State is the critical factor in plant and therefore in animal production. There are numerous rivers within the State, some large, but most of them small. The annual discharges of some of these rivers are indicated in the following table.

TABLE "A".

Annual Discharges of the Rivers of Utah.

River	Year	Discharge Acre-Feet
Bear River	1905	701,900
Blacksmith Fork	1905	74,570
Logan River	1905	146,700
Weber River	1906	398,460
Ogden River	1898	66,003
City Creek	1906	13,917
Parley's Creek	1906	18,569
Mill Creek	1906	11,782
Big Cottonwood Creek	1905	40,809
American Fork River	1905	36,270
Provo River	1904	279,900
Hobble Creek	1905	21,650
Spanish Fork River	1906	121,493
Sevier River	1905	96,941
San Pitch River	1905	46,860
Green River	1904	4,261,500
Ashley Creek	1904	92,180
Price River	1905	60,580
Strawberry River	1904	54,820
Duchesne River	1902	466,174
Lake Creek	1902	184,271
Uinta River	1903	185,540
Whiterocks River	1903	101,023

A number of reservoirs for the storage of water for irrigation purposes are also constructed or in process of constuction. The Reclamation Service is working upon the Strawberry Valley project which will reclaim many thousands of acres in the heart of the State, and the State itself has constructed a reservoir in a fertile part of southern Utah. There are, besides such reservoirs, hundreds of canals which take their water directly from the rivers. Many of these canals were constructed in the face of great difficulties during the early history of the State. Some of them represent untold sacrifices on the part of the farmers of the State. The indomitable pioneer spirit is yet manifest even to-day. For instance, in the southern part of the State, in the Rio Virgin district, the Hurricane canal has recently been constructed under the cooperative plan by farmers who were practically penniless except as they owned their little homesteads. For over a decade the community gave its whole support to the construction of this canal which is one of the great wonders of the world. It crawls along the mountain side, crosses ravines and chasms until it finally reaches the arid valley which now, by the magic of irrigation, is being converted into a garden of wealth.

The conservation movement in Utah must of necessity have as one of its chief objects the determination of the total amount of water which flows down the rivers and the investigation of the possibilities of storing this water for the benefit of man. It is to be hoped that the time will come when practically every drop of water running off Utah mountains may be held back in great reservoirs to be used on the arid lands as irrigation water throughout the summer season. When such a day shall come, seven to ten million acres of Utah lands may be brought under irrigation as against one million acres which is now the approximate irrigated area. At the best, however, the river waters of the State will cover only a small part of the whole State: not more than one-fifth of the whole area.

The maintainance of the canals and reservoirs of the State is also a problem that needs immediate attention, for much of the work of the past is being destroyed by improper

care. Moreover, from the various canals there are great losses by seepage and evaporation which should be controlled. The evaporation factor can not well be controlled in canals and reservoirs; but the seepage problem may be solved by the use of cementing materials of various kinds. Not only is there a direct loss to the farm of the water that seeps into the soils from the canals, but this seepage water dissolves a large quantity of valuable plant food which escapes to the lower valleys whrre the seepage water rises to the surface. It is in this way that alkali is formed, and it is a regrettable fact that the alkali problem is becoming a serious one in the State of Utah. In this day irrigation and drainage go hand in hand; whereas, under judicious methods of irrigation, it should be possible to eliminate almost wholly the drainage question, with the result that the water now wasted by seepage into the low lying lands would be used for the irrigation of the dry high lying lands. These problems of great importance for the consideration of the Conservation Commission also emphasize the undeveloped possibilities of this young State.

UNDERGROUND WATER SUPPLY.

Since the river waters, if fully conserved, will suffice to irrigate at the most only a fifth of the lands of this State, it naturaly follows that the question of securing more water for irrigation purposes is a vital one among the people of the State. Recent investigation has indicated that the great valleys of the State are underlaid by water. The Federal Government has made some study of this question and has succeeded in locating large bodies of underground water. The State administration, likewise, has spent time, money and effort upon this subject. To the joy of the people the State has already succeeded in reaching subterranean water that may be used for culinary and irrigation purposes in some of the most desert places of the State. The probabilities are that in the very near future artesian wells and the pumping of water from deep wells will be important factors in the reclamation of Utah. Just what proportion of the lands of the State

will be irrigated in this manner is difficult to foretell, but certainly it will be many hundreds of thousands of acres.

USE OF THE NATURAL PRECIPITATION.

The water resources of Utah can not well be dismissed without considering also the recent development in dry farming, which has taught that the natural precipitation of the State, if properly conserved in the soil, may be made to produce profitable crops without irrigation. When it is considered that twelve inches of water, properly stored in the soil, are sufficient to produce most of the ordinary crops, it follows that practically the whole of the State of Utah may be made agriculturally profitable. If enough rainfall does not fall in one season, it has been learned that the rainfall of two seasons may be stored in the soil and in that way crops may be obtained every other year. Even this is a great deal better than to leave the land as it is at the present time: lying idly as great deserts covered with useless plants. To teach the people the possibility of reclaiming the arid lands of the State without irrigation is not the least important work before the Conservation Commission.

THE WASTE OF WATER.

While water is the critical factor in Utah agriculture, yet it must be confessed that there is a great waste of water in our State. As in the other irrigated states, farmers have come to believe that the more water they apply to their soils, the surer are they of a large crop. The recent experiments carried on by the Utah Station as well as by the Federal Government have shown the fallacy of this idea, yet the new truth has not sunk deep into the consciousness of the farming population. It may be necessary to secure legislative enactment to control the use of water in order to prevent such waste. No man has the right to use more water than is really necessary, for, as explained above, it will ultimately result

in the bringing up of alkali somewhere in the State in addition to depriving some other piece of land from the water that is thus wasted.

CLASSES OF UTAH FARMING.

In accordance with the nature of the lands and the precipitation of the State the agriculture of Utah falls into three distinct classes. First, irrigation farming, which is confined to those portions of the State where artificial application of water has been made possible; second, dry farming, which covers those portions of the State where the rainfall is sufficient to produce crops without irrigation and where there is no irrigation water available, and, third, the range stock industry which represents the utilization of the vegetation growing on the mountains where the nature of the land forbids agricultural operations and the very desert portions of the State where the rainfall is not sufficient to produce crops without irrigation. These branches of Utah agriculture are all in a stage of transition, brought about by the recent rapid development of the State and the new knowledge which has come to the West concerning its agricultural practices.

IRRIGATION FARMING.

The irrigated area of the State it at the present time only about one million acres with a possible maximum of ten million of acres when all the waters in the State shall be held back in canals and reservoirs and used in the best way. There are about 2,200 irrigated farms in the State of Utah, averaging 45.5 acres each. According to the Government reports the amount of water used per acre is about 4.35 acre-feet. The crops grown on the irrigated lands at the present time are in the main, wheat, with other grains and lucern, and of the more intensive crops, potatoes, sugar beets, small fruits, apples, peaches and other fruits of that nature and garden truck. The income per acre varies with the crop grown, the care given the land and other local conditions. The personal fac-

tor is the main one in considering the profitableness of farming on the irrigated lands of Utah. The farmer himself is the first consideration in determining the success or failure of any farm. When the right crops are chosen, and the right care given the soils and plants, yields representing $100 to $1,000 per acre are not uncommon.

It may be noted that these irrigated farms of the State should be cut up into smaller farms. There has been in the past a desire on the part of the people to maintain large irrigated farms. There are thousands of farms in the State from eighty to two hundred acres. No man can do full justice to such a tract of irrigated land. We are coming more clearly to understand that from five to fifteen acres are quite sufficient to maintain a family in comfort and to provide against old age, providing, of course that the more intensive methods of farming are used. This is one of the directions in which the conservation movement can be of tremendous value to the development of Utah. The people should be taught the best methods of cultivation and the best crops in order to obtain the maximum returns for the outlay of time, money and energy. It should be shown that it is more satisfactory in every way for a man to do the best kind of work on a small farm than to do slipshod work on a large farm. If the people could be made to understand this, many more thousands of families could be maintained on the present irrigated section of the State.

DRY FARMING.

The possible dry farm area of Utah is practically all that which is not occupied by mountains or under irrigation canals, with the exception, perhaps, of some of the more desert districts where the rainfall is under ten inches. It would appear at the present time that wherever the rainfall is above ten inches dry farming may be made to succeed. While dry farming has been practiced in Utah for upwards of half a century—in fact, Utah is the pioneer dry farming state—yet it is only in recent years that dry farming has taken hold of

the general public. At the present time, dry farming is practiced in some degree in all the farming districts of the State. It is difficult to estimate just how many acres are being used for dry farm purposes, since the industry is growing so rapidly, but the area runs into hundreds of thousands of acres and may at the present time approach one million acres. The yields are very good. The chief dry farm crop is wheat, the average yield of which for the State is about twenty bushels to the acre. Barley, oats and rye are also successful dry farm crops. During the last three years, potatoes have also been found to do well without irrigation in districts that were formerly supposed to be hopeless deserts. Lucern does well on the dry farms, especially for seed production. Other fodder plants have been tested and almost without exception have been found to yield well. As a general rule it has been necessary to grow any new crop for some seasons under dry farm conditions before it has become adapted to arid conditions. However, plants readily adapt themselves to arid conditions and by a little experimentation successful results follow. The introduction of new plants and the adaptation of old plants to arid conditions are leading subjects in the reclamation of the dry lands of the State, which may well be fostered by the conservation movement.

It has been found also that crops grown on dry farms are much more nutritious than are those grown in humid climates. The nutritive value of wheat, for instance, is from one-tenth to one-fourth higher when grown on dry farms, so that one bushle of wheat represents a larger amount of feeding material. Potatoes and other crops, likewise, are improved as they are grown with a minimum of water. This fact should not be overlooked by the irrigation farmer who also desires to produce the highest quality of crops. In fact the dry farmers of the West have it in their power to compete most successfully with the great wheat growing districts because of the superior quality of the grain grown under arid climates. Fruit may be grown in small quantities on dry farms. It is somewhat smaller than that produced on the irrigated farms, but it is of very much finer flavor and quality.

No man can foretell at the present time where the end, with respect to dry farming will be. Of one thing we are certain, that within the State of Utah alone there are several empires now lying idle as deserts that will be reclaimed by the methods of dry farming. New discoveries by the experiment stations are showing how crop failures may be avoided. In fact, deep fall plowing for the conservation of the soil moisture, the fallowing of the land every other year, the planting of a comparatively small quantity of seed, keeping the plants tolerably far apart and the continuous cultivation of the top soil—all combine to make crop failures on dry farms an almost unheard-of-thing. The discovery that the underground waters may be reached on our Utah deserts makes possible the establishment of homes on our deserts There is no question that millions of people will obtain their living from the now barren deserts covering the larger portion of our State. Nor is it to be forgotten that the present crop yields are small in comparison with those that may be obtained as better methods of cultivation are discovered and applied. At the present time twenty bushels of wheat per acre is a fair dry farm average; but the various experiments carried on by the State indicate that it may be possible to secure from thirty to forty bushels under more improved methods of tillage. In order to facilitate the reclamation of the Utah deserts, the State Legislature authorized some years ago the establishment of six small experimental farms which have been of great value in showing the farmers in what localities of the State dry farming may be practiced and in teaching the most profitable methods to follow.

RANGE INDUSTRY.

The third branch of agriculture in Utah is the range industry. In former days, sheep and cattle were allowed to graze in the mountains and on the deserts to such a degree that many of the native grasses were thereby destroyed. In fact, there are millions of acres of land in the State today which, when the pioneers arrived, were covered with luxuriant gras-

ses, but which now are barren wastes because of the overstocking of live stock upon them. With the recent activity of the Forest Service, the formation of National Forests and the more general private ownership of the lands of the State, these lands have recovered in a measure their past condition. The large area of the State which never can be subjected to irrigation or dry farming makes it certain that the range industry will always be a leading branch of agricultural activity in Utah. There are problems awiting solution for the development of this branch of agriculture also. For instance, on the deserts which can not profitably be used for dry farming, grasses may be introduced which will appear perennially and furnish at least a scanty herbage for the range sheep during the winter season. Likewise, in the mountains there is a possibility of introducing new grasses and of spreading more generally the native grasses, in order to make the feeding possibilities of the mountain valleys greater than they are today. On the ranges are found great numbers of sheep, an abundance of cattle and large numbers of horses and mules. The possibilities of the ranges are yet poorly undersotod. The rough, haphazard methods of the past are going out of vogue and the new and more systematic methods are just being adopted. Although the National Forests are being established and greater regulation is insisted upon, yet there will be no reduction in the value of the range industry. On the contrary, as better methods for the care of mountains and deserts are developed, more than likely the range industry will become more valuable than ever before. The Conservation Commission can take a leading part in advancing this branch of Utah's resources.

GRAINS AND SEEDS.

The grains and seeds grown in Utah are chiefly wheat, oats, rye, barley, corn, together with lucern seed. As already remarked, wheat of extremely high quality is now largely grown on the dry farms. Oats, rye and barley are still grown chiefly on the irrigated farms. Corn has been found to be

the best of all crops for desert conditions and there is an opportunity for showing the way to greater prosperity by increasing the acreage of corn and in teaching farmers to feed this corn to live stock for fattening purposes. Our lucern seed is famous the world over and may be made even a more profitable source of revenue than it is at the present time. The following table shows the acreage and the total yields of crops in the State of Utah:

Estimated Acreage and Production of Crops in Utah for the Year 1908:

ESTIMATED ACREAGE AND PRODUCTION OF CROPS IN UTAH FOR THE YEAR 1908.

	Acres	Total Yield in Bushels
Wheat	241,865	6,072,220
Oats	52,923	2,116,920
Barley	10,897	326,910
Corn	10,296	360,360
Rye	3,000	78,000

FORAGE CROPS.

The chief forage crop of Utah is lucern which is grown most extensively on the irrigated farms, though the dry farms are gradually being seeded to lucern. There are large areas of irrigated lands lying somewhat low that are and should be used primarily for lucern production. The proper use of lucern in stock feeding has not yet been taught fully to the people of this State; nor is it fully understood. Of one thing we are fairly certain: that we shall learn in the near future to make better use of this important crop than we do at the present time. The total production of lucern during the year 1905 was 759,079 tons. Tame hays are also grown in considerable quantity, and wild hay is still a source of forage in this State. The total production of tame hay during the year 1905 was 50,034 tons.

SUGAR BEETS.

The sugar beet industry which was born in this State less than twenty years ago, has grown to very great proportions as an important source of revenue for the farmers of this State. There are in this State five sugar factories, using annually 399,218 tons of sugar beets and which return to the farmers $1,996,090.00 annually. The sugar beets grown in Utah contain a large percentage of sugar so that the business is a profitable one for the factories. There is yet considerable to be done in the matter of the development of even better methods than we have at the present time for the production of beets and also the proper use of the by-products of sugar factories. It may be said in this connection that the sugar factories of this State have been splendid agents in the dissemination of correct methods of agriculture among the people.

FRUIT GROWING.

Fruit growing is becoming a leading agricultural activity in the State, under irrigated conditions. Apples, peaches, pears, plums, small fruits, strawberries and garden truck are all produced in considerable quantities. The soils and the climate of Utah are remarkably well adapted to the production of apples and peaches. Large commercial orchards are being planted for this business. The wonderful yields of fruit on the deep fertile soils, the remarkable coloring and delicious flavoring have made possible the high promise that Utah in the near future will rank with the largest horticultural states of the Union. It is more than probable that she will lead in the production of the finest fruit. Utah is yet in her infancy in horticultural matters. The total acreage and the value of the fruit produced during the year 1908 are as follows:

	Acres	Value of Yield
Nurseries and Orchards	25,236	$1,410,000.00
Vineyards	951	96,000.00
Small Fruits	1,481	187,000.00
Garden Products	11,521	630,067.00

The large cities of the East and the mining camps of the West furnish markets for the fruit of the various parts of the State. Celery and similar vegetables of excellent quality are are also produced.

DAIRYING.

Dairying has also risen to a very high position in this State. There are at the present time about 90,000 animals on the dairy farms. In an irrigated state, dairying and horticulture must go together in order that the fertility of the soil may be maintained. According to the present custom, the farmer skims his milk at home or at a nearby skimming station and the cream is sent to a central station where it is worked up into butter. The skim milk is fed to the live stock of the farm. The farmer, therefore, gets the maximum return for the minimum of labor. Much needs to be done in dairying, however, by way of introducing better breeds of animals and maintaining a high degree of excellence in the animals used for dairying purposes.

LIVE STOCK.

The sheep business of the State is an important branch of the live stock industry. The total number of sheep and the wool produced during 1908 are as follows:

Number of sheep	3,115,000
Wool produced (lbs.)	14,700,000

Cattle, horses and mules are also produced in large numbers in the State. The poultry business in Utah, as in most other states, has been, until recently, a side issue with the average farmer. Of recent years, however, attempts have been made to specialize in poultry culture with very excellent success.

LIVE STOCK, 1908.

	Number	Average Farm Value	Total Farm Value
Horses and Mules	122,347	$70.00	$ 8,564,290
Cows	81,164	31.000	2,516,084
Other Cattle	327,496	17.00	5,567,432
Sheep	3,115,000	3.30	10,280,000
Swine	63,618	7.50	477,135
Bees (Colonies	52,115	.30	490,743

Poultry and eggs consumed	$2,452,000
Poultry and eggs produced	1,659,000
Poultry and eggs imported	793,000

When it is observed that at the present time $793,000 worth of poultry and eggs is shipped into the State annually, this branch of agricultural endeavor promises to become an important one for the farmers of this State.

AGRICULTURAL MANUFACTURES.

The agricultural manufactures of the State are devoted largely to the manufacture of butter, cheese, condensed milk, beet sugar, flour, canned goods, etc. The money value of these fctories is shown in the following table.

	Year	Value
Butter, Cheese and Condensed Milk	1905	$ 963,811
Flour and Grist Mill products	1905	2,425,791
Beet Sugar	1908	1,996,090
Canned Fruits and Vegetables	1908	963,575
Pickles and Vinegar	1908	253,119

These factories furnish a ready cash market for much of the agricultural product of the State. Especially those that are of the intensive kind.

MARKETS.

The markets of Utah for agricultural products are the larger cities and the mining camps. Those who are engaged in the range industry use large quantities of supplies for their

maintenance through the season. The sugar factories, flouring mills, canning factories and condenseries also have large markets in the surrounding states. Much Utah flour is shipped to the Orient.

NATURAL PLANT FOODS.

The maintenance of the fertility of the soil is a leading question in every agricultural state. While the natural fertility of Utah soils is very high, under incorrect practices there may come a time when there will be a shortage of some of the important plant foods. Nature seems to have provided against this emergency in Utah. Phosphates, which are most likely to be eliminated by improper methods of cultivation, are found in large deposits in Utah, Idaho and Wyoming. The quantity is immense and the availability for plant use is high. Potash is also found within the State in such a way as to make it of great agricultural importance. For instance, the waters of Great Salt Lake contains thousands of tons of potash which, by the employment of proper methods of isolation, may be secured for the fertilization of Utah soils. Factories will, undoubtedly, be established in the near future for the production of this commercial plant food for the maintenance of our soils. The nitrogeneous substances can be readily obtained from the use of nitrogenous crops on our farms.

The agricultural wealth of the State may be shown by the following table which exhibits the number of farms, the number of farmers and the average wealth of the farming population of the State.

AGRICULTURAL WEALTH—(1909).

Number of Farms	19,387
Number of Farmers	16,152
Average wealth	$3,878

THE FARM HOME.

The farm homes of the State are well adapted to the needs of the farmers. While there are yet remaining a large

number of buildings that were constructed in the early pioneer days, whenever these are replaced it is noticed that modern houses are constructed. Many of the barns, also, are of the old type, built in the days of the State's poverty, but the new barns are all of modern size and constructed according to modern methods of sanitation and convenience. There is, however, much to be done in this department of agricultural development and the Conservation Commission can, no doubt be of great service in pointing out to the farmers how more convenient and satisfactory home and barns can be built, which will increase the joy of living and minimize the labor necessary on the farm.

SOCIAL CONDITIONS.

The social conditions among the agricultural population are of the best. The Mormon Church, which predominates in the agricultural districts, has provided churches and various auxiliary organizations for young and old in all parts of the State. Other churches have done the same. The spiritual welfare of the people, therefore, is well looked after. Schools are found everywhere in the rural districts. In fact Utah is noted for the fact that she has usually built the school house first and the church afterwards. Libraries are being established in many towns of the State; and the library and gymnasium movement is growing rapidly throughout the State. The roads of the State are still in a very poor condition. There is here a crying need of organized effort both of the State as well as on the part of the local communities. The Conservation Commission can certainly be of great help in fostering the good roads movement. The State is fairly well supplied with railroads. Some of the most promising sections of the State are still without railroads, but surveys have been made recently and, undoubtedly, within the next few years railroads wil be extended to these important agricultural districts. There are few interurban roads. Telephones and telgraphs are found throughout the State. The telephone is now a necessity on the Utah farm. There are both life and

fire insurance companies organized within the State which cater to the agricultural population and it appears that they are being well patronized. Moreover, outside life and fire insurance companies do a flourishing business among the agricultural population of the State. The potable water supply of most of the cities of the State is of excellent quality. There are yet some districts in which water systems should be estalished. There are excellent opportunties throughout the State for securing water supplies from mountain springs that would protect the rural communties from the dangers of contaminated water. The fuel supply is good, when coal is considered, for there are immense deposits of coal throughout the State. The wood supply, however, is very limited, and it will be one of the problems of the Forest Service in this State so to care for the forests that the necessary amount of wood fuel may be grown there. Undoubtedly, also, the time will come when each farm will have to do something toward contributing to the wood supply of the State. The light supply of the State is excellent. Gas is practically unknown outside of Salt Lake City and Ogden, but a large proportion of the cities of the State are supplied with electric light. The fact that Utah consists of valley and mountains makes available an abundance of water power which is now being harnessed and converted into electric energy.

CONCLUSION.

The Utah farmers are of a high degree of intelligence. They represent all the states of the Union and most of the civilized countries of the world. Owing to the missionary system of the Mormon Church, a very large proportion of the men have traveled in various foreign countries of the world and are, therefore, richer in worldly experience than most of the agricultural communities of the land. Illiteracy is very low; schools are well patronized, and there is a general desire for a higher intellectual development and for a knowledge of the best methods of furthering the business of agriculture. Of course, there is yet much to be done for the full awakening

of the agricultural population. The Agricultural College of Utah, maintained by the State and Federal Government, is growing very rapidly. Leading farmers are sending their sons and daughters there to study agriculture and domestic science and related subjects. The State also also maintains, under the direction of the Agricultural College, an extensive and comprehensive extension department which holds schools of agriculture and domestic science in all the leading rural communities of the State.

The agriculture of Utah is characterized by great natural resources, an intelligent farming population and a new living interest in all that pertains to better methods of agriculture. The problems to be solved for the agricultural advancement in this State are necessarily complex, for all arid countries have special problems which have not been touched by modern, scientific agriculture which was founded largely in countries of abundant rainfall. Utah, however, is abreast with the states that are doing most for the establishment of practices that will fully develop the agricultural resources of the great West. Utah can maintain on her soils twenty times more farmers than she now has; and possibly then, by improved methods of culture, can double of treble the number.

WATER

IRRIGATION AND WATER POWER.

It is not the purpose of this Commission at this time to make a detailed report on the irrigation and water power resources of the State, but merely to give an outline of the scope of investigation and the objects sought to be obtained and reported later in a detailed statement of its findings on the subject of Water Conservation.

One phase of the question which needs correction is the diversity of interest in communities; or, to be more specific, the multiplicity of canals or ditches in many districts. For instance, there is a district of 20,000 acres, and the first settlers took out a ditch for 200 acres; later a ditch was taken out for 500, and so on until ten or fifteen ditches are constructed and each is operated under a separate ownership. In each of these ditches there is a separate and distinct interest from the others. It must be patent to the interested observer that in this multiplicity of ditches there will very naturally be a great waste of water from evaporation, leakage, etc., whereas if one or two large canals were constructed to cover all the acreage, the saving in cost of maintenance, in evaporation and in leakage would justify in many instances the cost of construction, and would still secure to the original appropriators full measure of protection as to their priority rights.

The State has sought to correct some of the abuses of the present system (or rather, lack of system) in the law providing for the filing of claims for priority or other rights in certain streams, notably the Weber and Ogden rivers in the northern part of the State, where such claims are filed in the District Court for adjudication, but have been delayed by the failure of the legislature to provide the necessary funds for the completion of the work This work when completed will prove of great benefit to the interests of irrigation in that section of the State, and to other sections when applied as the law contemplates.

As an instance, the Official Reports show where one of the small ditches claims an original right to sufficient water to be

equal to 14 acre-feet per acre. All of this water cannot possibly be used, but it is run out on the land and much of it evaporates and thus is wasted. How many similar instances there are cannot be determined until the courts shall act under the law, and fix the amount of water each person or company is entitled to, taking into consideration the acreage irrigated and the soil conditions.

The people on these streams were put to a very great expense to provide measuring devices on all of the ditches on the system (about 1300) and these have been left to rot and waste; and it would seem that unless some action is taken by the State soon most if not all this expense will have to be met again when the law is applied, and each person or ditch required to measure the water used.

In the way here set forth all of the natural flow of these streams (and the same will hold good largely throughout the State) has been appropriated. Like the man at the head of the ditch, the people at the head of these streams are accused of using more than their share of water, and these evils cannot be corrected other than by a system of allotment by measurement, such as is contemplated under the law. This law should be enforced.

Another evil which should be remedied as soon as possible and into which careful inquiry should be made in order to ascertain the exact facts and conditions in relation to the subject, is the ownership of large blocks of stock or shares in canal companies by parties not owning land under the canals, or if they do own land, leave it unused or dry-farm and rent their shares of water at a yearly rental. The effect of this is that in some localities well adapted to horticulture, and where under advanced methods the farm of 10 to 20 acres is paying $200 to $400 and more per acre per year, these small farms are worth $500 per acre. It is a fact that many of these small holdings are renting their water for a yearly rental of from $8 to $12.50 and doing well. They are building homes and building up the State by paying the taxes, whereas the owner of the water (shares) is not taxed on his water shares nor is he taxed on his land—if it is used as above mentioned—equal to the man who has made the improvements. And so the

public is being defrauded and the growth of the State is being retarded so far as this system prevails.

For the benefit of the people and the growth of the State the water should be fixed to the land within such limits as will not work a hardship on the farmer or horticulturist.

There are approximately 125,000 acres of the best fruit lands in the State situated in Utah, Tooele, Salt Lake, Davis and Weber counties, which it is possible to irrigate thoroughly from the run-off or waste waters of the Provo and Weber rivers if it were stored or conserved in reservoirs. The run-off of the Provo river into Utah Lake for the year 1904 was 166,500 acre feet. The Weber river for the same year had a run-off into Salt Lake of 770,800 acre feet, making a total of waste water from the two rivers of 937,300 acre feet. Allowing two acre feet per acre this would give a good safe margin of 687,500 acre feet for shortages.

The 125,00 acres irrigated are worth $25 per acre or $3,125,000. Irrigated and improved, they would be worth $200 per acre, or $25,000,000. Similar conditions may exist in other portions of the State. Hence the necessity of careful inquiry.

IRRIGATION COMPANIES NOW IN UTAH.

There are 681,048 acres of land irrigated by 2,179 miles of irrigation canals in Utah now in use, representing an outlay in cash of $7,522,291, as shown in a report on irrigation companies compiled recently by H. T. Haines, state statistician. The report is the first one which has been made up in the history of the State and contained a list of the companies reporting capitalization, cost of canals, their length and cost of maintenance, the number of acres irrigated and other figures.

Mr. Haines believes his report covers more than 75 per cent of the incorporated irrigation companies in the State, but does not include many small companies operated by one or more farmers in various neighborhoods. Neither does it include any government or State land reclamation enterprises.

"I have had a good deal of trouble getting the report together," said Mr. Haines, recently, "owing to the fact that

many of the officers of companies have been slow in reporting. In some cases I have sent as many as six inquiries before getting the data asked for, and there are still some companies which will report from time to time. These will be added to the repore in the annual compilation and made a part of the State Auditor's report. In some cases this is caused by change in secretaries, the one going out not leaving figures for the incoming officer, who has to make a guess. Another difficulty is that we were not able to tell which were live and and which were dead companies. Many of these I have written to have been out of existence for years, without a record. The corporation tax will eliminate this in the future, but just now we have no way of finding which companies are alive and doing business.

"There is no record of the cost of the canals which were constructed forty and fifty years ago, either. In most instances in those days, the farmers got together and took turns in digging the canals, without records being kept of the estimated cost of the canals. Then, too, in many cases dry creek beds, gulches and other depressions have been used for canals, and the cost therefore has been lessened. The wide difference in the cost of canals is thus explained. Loose business methods and carelessness prevail in keeping the records and accounts by many of the officers of irrigation projects today, for it is found that the secretaries are unable to give but very little information concerning the companies they represent.

"There is a bad showing from some of the counties, owing to the fact that officers of the companies there have failed to give me any information which could be used in the report. I believe this will arouse the people of those counties and others, so that within another year I will be able to give practically a complete statement of the mileage and cost of canals in the State, and other information in this line which will be of interest to people of this State and others."

The compiled table of canals and reservoirs is as follows:

Counties.	No. of Companies Reporting.	Capitalization.	Estimated Cost of Canals.	Canals, Length Miles.	Cost of Maintaining Canals, 1908.	Estimated No. Acres Irrigated, 1908.	No. of Reservoirs Reporting	Estimated Cost of Reservoirs, 1908.	Cost of Annual Maintenance.	Estimated Cost of Reservoirs.
Beaver	4	$ 19,870	$ 20,670	11.8	$ 1,016	4,712	1	$	$	$ 1,500
Box Elder	10	438,814	1,351,430	213.8	41,225	49,860	2	11,000	.....	.....
Cache	29	453,801	618,826	147.9	24,017	116,574	2	11,000	500	.....
Carbon	6	536,338	206,138	52.7	5,018	3,350	1	165,000	3,000	.....
Davis	8	167,850	39,100	33.0	4,300	9,840	..	.....	.....	.....
Emery	9	711,552	328,226	193.4	21,920	72,700	4	83,738	3,128	5,000
Garfield	5	33,800	31,600	17.1	2,575	5,528	1	3,000	250	.....
Grand	2	30,000	31,228	13.1	4,500	1,800	..	.....	.....	.....
Iron	7	128,175	19,400	14.7	673	5,065	1	2,500	.....	.....
Juab	8	72,900	49,300	23.5	2,690	3,534	1	1,025	.....	.....
Kane	3	69,048	26,800	9.4	1,716	1,552	..	.....	.....	.....
Millard	10	1,224,628	249,150	81.6	4,150	52,310	3	321,500	2,500	6,180
Morgan	2	8,760	7,728	5.6	310	1,063	..	.....	.....	.....
Piute	3	13,500	11,112	15.8	678	6,314	..	.....	.....	.....
Rich	8	141,256	92,188	61.6	3,020	34,680	..	.....	.....	.....
Salt Lake	13	963,255	992,460	117.7	33,328	50,405	..	.....	.....	.....
San Juan	1	100,100	98,000	7.5	800	750	..	.....	.....	.....
Sanpete	29	781,551	335,335	176.7	7,475	42,902	6	161,707	1,920	2,550
Sevier	23	300,390	91,230	111.9	10,628	25,738	5	143,400	700	2,800
Summit	13	151,223	149,915	59.3	3,827	9,751	1	5,000	.....	.....
Tooele	5	146,499	83,711	28.0	1,375	2,800	..	.....	.....	.....
Uintah	15	635,778	481,992	163.7	10,931	38,880	1	190,000	2,000	.....
Utah	24	1,298,923	523,380	171.8	14,517	54,331	2	105,000	1,100	20,000
Wasatch	28	570,526	852,171	219.7	15,722	38,010	3	65,000	275	.....
Washington	20	259,702	248,750	60.0	10,930	9,245	2	.....	.....	.....
Wayne	2	65,000	36,000	46.0	2,394	7,700	1	9,650	497	.....
Weber	21	1,093,321	546,451	121.7	14,590	31,654	..	100,000	500	.....
Total	307	$10,425,560	$7,522,291	2,179.0	$2,44,325	681,048	37	$1,378,520	$16,370	$ 38,030

HYDROGRAPHIC WORK OF THE U. S. GEOLOGICAL SURVEY IN THE STATE OF UTAH.

In the year 1889 the Geological Survey began the study of the water resources in the State of Utah. During this year, gaging stations were established on Bear river near Colliston, and Provo river at the mouth of the canyon. The behavior of these two Utah rivers is pretty well known at the present time, as a practically complete daily record of the flow in cubic feet per second has been kept for a period of twenty years.

With the exception of a few scattering records kept by the army engineers, there was very little data collected bearing on the water resources of the United States prior to the year 1889. This work has gradually increased from year to year, as fast as funds would permit, until at the present time a systematic study is being made of the water resources of practically every state and territory in the Union, including Alaska and the Hawaiian Islands.

At the present time, this work is carried on by the Water Resources Branch of theUnited States Geological survey under the direction of George Otis Smith, Director of the United States Geological survey, and M. O. Leighton, chief hydrographer of the Water Resources Branch.

The United States has been divided into districts; the work in each district being under the direction of a district engineer. The State of Utah is included in what is known as The Great Basin district, which comprises the states of Idaho, Utah and Nevada. E. C. LaRue, district engineer, has charge of the work in these three states.

On account of the small appropriation by the Federal Government, only a small amount could be allotted for the study of the water resources of the state of Utah. Consequently, the work has increased slowly. However, the hydrographic investigations, carried on by the Government in the western states, have led to the construction of irrigation works, costing approximately $50,000,000 in the last six years. The construction of these large irrigation projects would no doubt

have been delayed indefinitely, had it not been for the long-time records, showing the vast amount of water running to waste each year in these western rivers. This has directed the attention of civil engineers to the study of the feasibility of hundreds of smaller irrigation projects.

There are thousands of acres of land in southern Utah that are practically worthless without irrigation. With the development of the available waters, the value of these lands can be raised to several million dollars. This development could not take place without a reliable record of the flow of the streams. During the last session of the Legislature, a bill was passed authorizing the state engineer to co-operate with and spend dollar for dollar with the Government in order to extend the hydrographic investigations to cover southern Utah. As a result, the water resources of the state of Utah are now being carefully studied under the direction of E. C. LaRue, District Engineer for the United States Geological Survey, and Caleb Tanner, Engineer for the State of Utah.

The work in this state has nearly doubled during 1909. At the present time a daily record, in cubic feet per second, is being kept on the following streams in Utah.

Bear River at Colliston.
Beaver Creek at Minersville.
Blacksmith Fork River at Hyrum.
Power Plant Race at Hyrum.
Box Elder Creek at Brigham.
Cottonwood Creek at Orangeville.
Diamond Fork River at Thistle.
Escalante Creek at Escalante.
Ferron Creek at Ferron.
Fremont River at Thurber.
Green River at Elgin.
Hobble Creek at Springville.
Huntington Creek at Huntington.
Indian Creek at Strawberry Valley.
Logan River at Logan.
Logan Hyde Park and Smithfield canal at Logan.
Muddy Creek at Emery.
Peteetneet Creek at Payson.
Price River at Helper.
Provo River at Forks.
San Rafael at Green River.
Santa Clara River at Enterprise.
Santa Clara River at St. George.
Sevier River at Gunnison.
Sevier River at Marysvale.
Spanish Fork River at Lake Shore.

Spanish Fork River at Spanish Fork.
Spanish Fork River at Thistle.
Strawberry River at Strawberry Valley.
Trail Hollow Creek at Strawberry Valley.
U. S. R. S. Power Canal at Spanish Fork.
Virgin River at Virgin.
Weber River at Devil's Slide.
Weber River at Oakley.
Weber River at Plain City.

The records from these stations are published annually by the Water Resources Branch of the United States Geological Survey, and may be consulted or obtained by writing the Director of the United States Geological Survey, Washington, D. C.; or E. C. LaRue, 307 Brooks' Arcade building, Salt Lake City, Utah. The 1909 records will be published early in the spring of 1910.

STRAWBERRY VALLEY PROJECT.

The Strawberry Valley Project contemplates the irrigation of approximately 60,000 acres of mesa and bottom land lying about sixty miles south of Salt Lake City, on the east shore of Utah Lake.

When completed, the irrigation works will consist of the following features:

The Strawberry Reservoir, in which it will be possible to impound 110,000 acre-feet of water by erecting a dam 45 feet high across Strawberry river; the Strawberry tunnel, 19,000 feet long, with a capacity of 500 second-feet, by which the water from the Strawberry reservoir is taken through the rim of the great basin; concrete diversion dam and headworks on the Spanish Fork river, the dam to be 16 feet high and 70 feet long; power canal 3 miles long, having a capacity of 500 second-feet; about 40 miles of main distributing canals, with necessary turnouts and laterals; a hydro-electric power plant that will develop 3,000 horse power, the power from which will be used for pumping water for irrigation purposes, and lighting the towns on the project.

To date the following features have been completed:

Telephone line, 38 miles long, extending from Spanish Fork to the several prominent features on the project, and

both portals of the Strawberry Tunnel. This line will be used during the period of construction of the project, and afterwards in connection with its operation and maintenance.

As a primary step in the construction of the project, a wagon road 32 miles long, has been constructed from the D. & R. G. railroad by way of the West Portal of the Strawberry tunnel to the Strawberry reservoir site.

The concrete diversion dam on Spanish Fork river has been completed, together with three miles of power canal. There are 1500 feet of tunnel on the power canal, and some 8,000 feet of the canal is lined with concrete. The canal has a capacity of 500 cubic feet per second from the Diversion dam to the power house, where one-half of the water will be dropped 160 feet through the wheels of the power plant, and the remaining 250 cubic feet will be turned into the high line canal.

A power house containing two 450 K. W. generators; two 600-horse power turbine water wheels, together with exciters, and accessories; also a power transmission line extending from the power house to the west portal of the Strawberry tunnel, a distance of 30 miles, has been completed.

The west portal of the Strawberry tunnel has been opened up, and to date 3,700 feet of tunnel has been excavated. Power for the construction of the tunnel is being supplied from the power house on the lower part of the project, and the work of excavating the tunnel is being pursued as rapidly as possible with three shifts.

RIVERS AND STREAMS.

As nearly as can be stated at this time, the following tables will tell the volume of water in the measured streams of Utah. The list is by no means complete, and can not be until all waters of the state shall have been gauged and recorded. But the data, so far as secured, comes through the courtesy of Government employes:

Station Rating Table for Bear River Near Collinston, Utah, from January 1 to December 31, 1905.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Second feet*	*Feet*	*Second feet*	*Feet*	*Second feet*	*Feet*	*Second feet*
—0.55	10	0.40	266	1.40	868	2.40	1,850
—0.50	15	0.50	310	1.50	950	2.50	1,960
—0.40	29	0.60	356	1.60	1,035	2.60	2,075
—0.30	47	0.70	406	1.70	1,125	2.70	2,190
—0.20	68	0.80	460	1.80	1,220	2.80	2,310
—0.10	92	0.90	518	1.90	1,320	2.90	2,435
.00	120	1.00	580	2.00	1,420	3.00	2,560
.10	152	1.10	646	2.10	1,525	3.10	2,690
.20	187	1.20	716	2.20	1,630	3.20	2,830
.30	225	1.30	790	2.30	1,740		

Note.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-05. It is well defined between gage heights 1.3 feet and 2.5 feet.

Rating Table for Logan River Near Logan, Utah, for 1906.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*
1.60	30	2.10	194	2.60	410	3.10	672	3.60	964
1.70	60	2.20	232	2.70	460	3.20	728	3.70	1,026
1.80	92	2.30	274	2.80	510	3.30	786	3.80	1,088
1.90	124	2.40	318	2.90	562	3.40	844		
2.00	158	2.50	362	3.00	616	3.50	904		

Note.—The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1906, and is fairly well defined.

Rating Table for Blacksmith Fork Near Hyrum, Utah, for 1906.

Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	18	3.60	75	4.00	163	4.40	273	4.80	402
3.30	29	3.70	94	4.10	189	4.50	304	4.90	
3.40	42	3.80	115	4.20	216	4.60	336		
3.50	57	3.90	138	4.30	244	4.70	369		

Note.—The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1905-6, and is well defined.

Rating Table for Weber River Near Oakley, Utah, for 1905-6.

Gage height	Discharge	Gage height.	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	46	4.80	209	5.50	490	6.20	917	6.90	1,490
4.10	58	4.90	241	5.60	542	6.30	990	7.00	1,580
4.20	73	5.00	275	5.70	597	6.40	1,066	7.20	1,760
4.30	90	5.10	312	5.80	655	6.50	1,145	7.40	1,940
4.40	109	5.20	352	5.90	716	6.60	1,227	7.60	2 120
4.50	130	5.30	395	6.00	780	6.70	1,312	7.80	2,300
4.60	154	5.40	441	6.10	847	6.80	1,400	8.00	2,480
4.70	180								

Note.—The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904-6 and is well defined between gage heights 4.0 and 6.0 feet.

Discharge Measurements of Lost Creek Near Croyden, Utah, in 1905.

Date	Hydrographer	Width	Area of Section	Mean velocity	Gage height	Discharge
		Feet	*Square Feet*	*Feet per second*	*Feet*	*Second-feet*
February 2	W. G. Swendsen	30	24	1.00	2.85	24
May 2 *a*	do	27	72	2.53	3.50	181
June 28	do	26	15	1.00	2.68	15
August 19	W. D. Beers	20	12	.82	2.60	10

a Gaging made at bridge

Discharge Measurements of Chalk Creek at Coalville, Utah, in 1905.

Date	Hydrographer	Width	Area of section	Mean velocity	Gage height	Discharge
		Feet	*Square feet*	*Feet per second*	*Feet*	*Second-feet*
March 8	W. G. Swendsen	34	21	0.77	1.42	16
May 1	do	44	64	2.45	2.25	154
June 16	do	32	42	1.58	1.86	67
June 27	do	38	28	.80	1.50	22

Rating Table for Provo River Above Telluride Power Company's Dam, Near Provo, Utah, for 1906.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*
3.50	100	4.30	442	5.10	814	5.80	1,146	6.50	1,480
3.60	142	4.40	486	5.20	862	5.90	1,194	6.60	1,526
3.70	184	4.50	530	5.30	912	6.00	1,242	6.70	1,576
3.80	226	4.60	576	5.40	958	6.10	1,288	6.80	1,626
3.90	268	4.70	622	5.50	1,004	6.20	1,336	6.90	1,776
4.00	310	4.80	670	5.60	1,050	6.30	1,384	7.00	1,826
4.10	354	4.90	718	5.70	1,098	6.40	1,432	7.10	1,876
4.20	398	5.00	766						

Note.—The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1906 and is fairly well defined.

Estimated Monthly Discharge of American Fork Near American Fork, Utah, for 1905.

[Discharge area, 66 square miles.]

Month.	Discharge in second-feet			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-ft. per square mile	Depth in inches
January	27	23	24.0	1,476	0.364	0.420
February	26	11	23.0	1,277	.348	.362
March	31	26	29.2	1,795	.442	.510
April	97	28	49.9	2,969	.756	.844
May	184	56	110	6,763	1.67	1.92
June	239	107	176	10,470	2.67	2.98
July	104	40	65.1	4,003	.986	1.14
August	40	27	32.7	2,011	.495	.571
September	38	25	27.4	1,630	.415	.463
October	29	22	24.5	1,506	.371	.428
November	23	17	21.5	1,279	.326	.364
December	20	16	17.8	1,094	.270	.311
The Year	239	11	50.1	36,270	.759	10.31

Station Rating Table for Hobble Creek Near Springville, Utah, from May 31 to December 31, 1905.

Gage height	Discharge.	Gage height	Discharge.	Gage height	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
1.10	7.0	1.40	30.5	1.70	61	2.00	99
1.20	14.5	1.50	40	1.80	73	2.10	113
1.30	22.0	1.60	50	1.90	86		

Note.—The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1905. It is well defined between gage heights 1.2 feet and 1.8 feet.

Monthly Discharge of Spanish Fork Near Spanish Fork, Utah, for 1906.

[Drainage area, 670 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec-feet. per-sq. mile.	Depth in inches.
January	89	48	66.4	4,080	0.099	0.11
February	100	57	76.0	4,220	.113	.12
March	455	53	158	9,720	.236	.27
April	594	122	369	22,000	.551	.61
May	907	354	611	40,600	.987	1.14
June	456	180	304	18,100	.454	.51
July	169	104	132.0	8,120	.197	.23
August	148	88	99.5	6,120	.149	.17
September	120	81	93.6	5,570	.139	.16
October	81	74	80.3	4,940	.120	.14
November	88	68	81.0	4,820	.121	.14
December	120	62	84.7	5,210	.126	.15
The Year	907	48	184.0	134,000	.274	3.75

Rating Table for Beaver Creek Near Beaver, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft*	*Feet*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	52	3.60	103	4.10	183	4.50	269	4.90	399
3.20	59	3.70	117	4.20	202	4.60	297	5.00	439
3.30	68	3.80	132	4.30	222	4.70	328	5.10	482
3.40	78	3.90	148	4.40	244	4.80	362	5.20	528
3.50	90	4.00	165						

Note.—This table is based on 4 discharge measurements and is not well defined.

Station Rating Table for Sevier River Near Gunnison, Utah, from January 18 to December 15, 1905.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Second-ft.*	*Feet*	*Second-feet*	*Feet*	*Second-feet*	*Feet*	*Second-feet*
0.40	17	1.20	101	2.00	254	2.80	474
0.50	24	1.30	116	2.10	278	2.90	506
0.60	32	1.40	132	2.20	303	3.00	539
0.70	41	1.50	149	2.30	329	3.10	573
0.80	51	1.60	168	2.40	356	3.20	608
0.90	62	1.70	188	2.50	384	3.30	644
1.00	74	1.80	209	2.60	413	3.40	681
1.10	87	1.90	231	2.70	443		

Note.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 0.4 feet and 1 foot and fairly well defined above 1 foot.

Station Rating Table for San Pitch River Near Gunnison, Utah, from January 1 to December 31, 1905.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Second-feet*	*Feet*	*Second-feet*	*Feet*	*Second-feet*	*Feet*	*Second-feet*
1.70	10	2.10	49	2.50	123	2.90	227
1.80	15	2.20	64	2.60	146	3.00	258
1.90	24	2.30	82	2.70	171	3.10	290
2.00	35	2.40	102	2.80	198	3.20	324

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902-1905. It is well defined between gage heights 1.65 feet and 2.5 feet.

Rating Table for White River Near Dragon, Utah, for 1906.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*
3.30	505	4.10	815	4.90	1,200	5.70	1,665	7.00	2,560
3.40	540	4.20	860	5.00	1,255	5.80	1,730	7.20	2,710
3.50	575	4.30	905	5.10	1,310	5.90	1,795	7.40	2,860
3.60	610	4.40	950	5.20	1,365	6.00	1,860	7.60	3,010
3.70	650	4.50	1,000	5.30	1,420	6.20	1,990	7.80	3,170
3.80	690	4.60	1,050	5.40	1,480	6.40	2,130		
3.90	730	4.70	1,100	5.50	1,540	6.60	2,270		
4.00	770	4.80	1,150	5.60	1,600	6.80	2,410		

Note.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and is fairly well defined. The high water of May caused a great change in area at the measuring section, but did not materially alter the relation of discharge to gage height.

Rating Table for Duchesne River Near Myton, Utah, for 1904 and 1906.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*
5.40	423	6.20	1,005	7.00	1,890	7.80	3,040	9.20	5,510
5.50	484	6.30	1,109	7.10	2,020	7.90	3,205	9.40	5,890
5.60	548	6.40	1,200	7.20	2,150	8.00	3,375	9.60	6,270
5.70	615	6.50	1,305	7.30	2,290	8.20	3,715	9.80	6,650
5.80	685	6.60	1,415	7.40	2,430	8.40	4,070	10.00	7,030
5.90	760	6.70	1,530	7.50	2,575	8.60	4,430	10.20	7,410
6.00	840	6.80	1,650	7.60	2,725	8.80	4,790		
6.10	920	6.90	1,770	7.70	2,880	9.00	5,150		

Note.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1904 and 1 during 1906, and is well defined.

Rating Table for Strawberry River in Strawberry Valley, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	92	2.50	207	3.10	351	3.70	511	4.60	770
2.00	109	2.60	229	3.20	377	3.80	539	4.80	830
2.10	127	2.70	252	3.30	403	3.90	567	5.00	892
2.20	146	2.80	276	3.40	430	4.00	595	5.20	954
2.30	166	2.90	300	3.50	457	4.20	652	5.40	1,017
2.40	186	3.00	325	3.60	484	4.40	710		

Note.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1905-6, and is well defined.

Rating Table for Indian Creek in Strawberry Valley, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.3	36	1.7	72	2.1	117	2.5	167	2.9	222
1.4	44	1.8	83	2.2	129	2.6	180	3.0	236
1.5	53	1.9	94	2.3	141	2.7	194	3.1	250
1.6	62	2.0	105	2.4	154	2.8	208		

Note.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6, and is well defined.

Rating Table for Price River Near Helper, Utah, for 1905-6.

Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
Feet	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*
3.00	1	3.60	60	4.20	219	4.80	508	5.80	1,145
3.10	4	3.70	78	4.30	260	4.90	563	6.00	1,295
3.20	9	3.80	98	4.40	305	5.00	600	6.20	1,450
3.30	18	3.90	122	4.50	354	5.20	740		
3.40	30	4.00	150	4.60	404	5.40	870		
3.50	44	4.10	182	4.70	455	5.60	1,005		

Note.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906, and is well defined.

The water power possibilities in Utah are limited in comparison with other States in the Rocky Mountain region, because of the small supply of water in some seasons of the year.

The streams of the State are fed largely from melting snows in the high mountains. In the early summer, May and June, the snows on the lower ranges melt and run off, causing the flooding of the low land near their outlets into the lakes or into the larger streams that run to the sea. These mountain streams are generally small, hence there is not much power in them, due largely to the fact that after the flood season is over, they are fed from the melting snows in the very high mountains, which after melting runs into the ground and percolates in springs along the banks of the upper portions of the streams, and thus a small supply is continued throughout the year.

The supply of electricity for lighting and power purposes is not nearly equal to the demand at present, and as the State increases in population the demand for power and light will increase, and it is apparent that all the power there is in the streams of the State should be conserved and put to beneficial uses.

So far as the Commission is aware, there has been no systematic investigation of this subject, so that until such investigation is made, only limited information can be given.

The following list of a few streams will give some idea of the possibilities. The data is taken from information obtained through the State Engineer's office. The tables given are for the year 1906, and as nearly as possible the measurements were taken at points where the stream could be utilized for power and not materially interfere with the use of the water for irrigation:

American Fork Creek. (Utah County.)

Drainage area	670	Square miles.
Fall in 15 miles	2,500	Feet.
Maximum flow	907	Second feet.
Minimum flow	48	Second feet.

Period of 12 months, January to December.

Bear River (Cache Junction to Collinston.)

Drainage area	6,000	Square miles.
Fall in 7 miles	140	Feet.
Maximum flow	7,080	Second feet.
Minimum flow	585	Second feet.

Period 7 months, January to July.

Beaver Creek (Beaver County.)

Fall in 32 miles	1,451	Feet.
Maximum flow	528	Second feet.
Minimum flow	52	Second feet.

Blacksmith Fork (Cache County).

Fall in 5 miles	1,400	Feet.
Maximum flow	304	Second feet.
Minimum flow	29	Second feet.

Big Cottonwood (Salt Lake County).

Drainage area	49.5	Square miles.
Fall in 10 miles	3,750	Feet.
Maximum flow	288	Second feet.
Minimum flow	19	Second feet.

Logan River (Cache County.)

Drainage area	218	Square miles.
Fall in 15 miles	1,000	Feet.
Maximum flow	1,090	Second feet.
Minimum flow	60	Second feet.

Ogden River (Weber County).

Drainage area	360	Square miles.
Fall in 10 miles	720	Feet.
Maximum flow	2,178	Second feet.
Minimum flow	195	Second feet.

Provo River (Utah County).

Drainage area	800	Square miles.
Fall in 35 miles	1,900	Feet.
Maximum flow	1,880	Second feet.
Minimum flow	100	Second feet.

Parley's Creek (Salt Lake County).

Fall in 10 miles	2,750	Feet.
Maximum flow	146	Second feet.
Minimum flow	4	Second feet.

Weber River (Summit, Morgan & Weber Counties).

Drainage area	1,200	Square miles.
Fall in 42 miles	1,730	Feet.
Maximum flow	3,210	Second feet.
Minimum flow	140	Second feet.

The United States Geological survey and the State engineer of Utah are making investigations on the streams in the southern and southeastern portions of the state, which when completed will enable this Commission to make a more complete report on the water resources of the state.

MINERALS

MINERAL RESOURCES OF UTAH.

It was in the latter part of 1863 that General P Edw. Connor, the commander of the United States troops at Camp Douglas, made the first move toward the opening of the Utah mines. The Mormon pioneers who arrived in Salt Lake valley in 1847, fully realizing their isolated condition, had turned their attention to those industries requisite for making the people self-sustaining. Among their temporal pursuits agriculture was exalted as the basis of their prosperity, with home manufactures next. Iron and coal mining was encouraged, but not other mining, although evidences were not lacking that the mountains of the Territory treasured much gold and silver, as well as lead, zinc and copper.

It was during the first year of General Connor's sojourn in the Territory that he, while enjoying a picnic party in Bingham Canyon along with other officers of Camp Douglas, located the first mine in what was to become one of the greatest mining states of the Union. This mine he named the Jordan. Other claims were soon located in Bingham, and General Connor wrote up some mining laws which were adopted at a miners' meeting held at Gardner's mill on the Jordan river, where the district was named the West Mountain Mining District, and Bishop Archie Gardner was elected recorder. Thus was the first mining district organized in the Territory.

In the Wasatch mountains the first discovery of ore was made in Little Cottonwood canyon, by General Connor, in the summer of 1864, but it was 1868 before the Little Cottonwood Mining District was organized. Not much was done in the development of these districts until the coming of the railroad across the continent. True, much money was expended by Connor and his California friends in exploiting the claims and building furnaces at various camps, but owing to unfavorable conditions, including the inexperience of workmen, the efforts failed.

The first shipment of ore from Utah was made in the summer of 1869. It was galena ore from the Emma mine of

Little Cottonwood, and was shipped to the Selby Smelter of San Francisco. Many rich shipments followed, including a lot of forty tons from the East Canyon, now Ophir District, in the Oquirrh Mountains, shipped west by Walker Brothers, which netted $24,000. The success of these ventures gave an impetus to mining all over the Territory. From the summer of 1869 to the fall of 1871 ten thousand tons of silver and gold ores, valued at $2.500,000; four thousand and five hundred tons of gold and silver bearing bullion worth $1,237,000; and two hundred and thirty-one tons of copper ore valued at $6,000 were shipped from the Territory.

In 1868 the number of mining districts in the Territory was two; in 1871 there were 32.

The completion of the Utah Central railroad in the spring of 1870, with its extensions later into Bingham, Little Cottonwood and American Fork canyons, did much toward the development of the mining industry.

From the advent of the railroad until the present there has been a healthy consistent growth in this important industry in Utah. The state's present prominence in mining has been gained gradually, and as a result of extensive development of enormous, medium and low grade deposits. There have been few spasmodic and temporary gains in her metallic output, neither have there been serious losses, as the years of prosperity and adversity in mining arrived. Her advance has been rapid but regular, and the prospects are brighter now for increased output in future years than they ever were before.

The dividends from Utah's mines and smelters indicate the substantial nature of these industries. For 1909 the reported dividends amount to practically $9,000,000, with prospects for greater dividends for 1910.

For the year 1908 Utah ranks third in lead, fourth in silver and copper, and fifth in gold among the states of the Union.

The total output of the four metals (lead, silver, gold, and copper) for Utah during the last ten years, has averaged from $25,000,000 to $32,000,000 per year, according to statistics compiled by the United States Geological Survey.

The total output of these four metals in the state up to date has reached $450,000,000.

But mining in Utah is yet in its infancy. Mother nature has shown us great favor during the geological history of our state, in the operation of her dynamic forces, that have folded and faulted the rock layers of this portion of the earth's crust, bringing to the surface, and hence within the ready access of man, layers and deposits that could otherwise be reached only by miles of vertical excavation. What treasures are stored up in our mountains has scarcely begun to be known. Recent developments in many camps have revealed phenomenal ore bodies. The Tintic district, for example, has long been producing an enormous tonnage of smelting ores; but during the past three years the new mines about Godiva Mountain have discovered extensive bodies of excellent ore. The dividends paid by two of these mines in 1907 amounted to approximately one million dollars. And the older producers of Tintic are showing richer values and larger ore bodies with increased development. Some of these properties are now worked to a vertical depth of nearly a half mile.

But Tintic is no exception, for Park City the famous silver-lead camp was never looking better than now, and as for Bingham—her resources are considered one of the wonders of the mining world.

The tremendous ore supply from the three camps above mentioned, along with that of many other important Utah camps, as well as the mines of Nevada, Idaho and even California has justified the building of mammoth smelting plants in Salt Lake Valley, so that Salt Lake City is at present the most important smelting center in the world. These smelters with their competition for custom ores are giving very favorable smelting rates to the ore producer.

Some of the more important mining districts of the state will be considered in detail.

OUTCROPPINGS OF IRON ORE.

BINGHAM.

MINING DEPOSITS.

As a preface to the consideration of some of the larger mines of Bingham, we quote from the summary of the geology of this area in the Monograph on Bingham by the United States Geological Survey. "Between carboniferous and late tertiary time monzonite intrusives invaded sediments in the Bingham area, metamorphized them, and introduced metallic elements which replaced marbleized limestone with pyritous copper sulphides. After the superficial portions of the intrusives had cooled to at least partial rigidity, they and the enclosing sediments were rent by persistent northeast-southwest fissures.

"Heated aqueous solutions from below then ascended, producing alterations, and introducing metallic minerals. Later the original sulphide ores, altered by surface waters, were oxidized in the upper layers, and secondarily enriched below by changing to black copper sulphides with the addition of gold and silver."

As a result of this process of mineralization there is found in the camp three types of deposits, namely: (1) the disseminated ore of the monzonite laccolith and the contiguous quartzite; (2) the sulphide lode or vein ores; and (3) the replacement or bed ores in limestone. The first type is known in the district as "porphyry ore," and the others as the "sulphide ores," since they contain pyrite or iron sulphide as the predominating mineral. Important mines are now producing from each of these classes of ores.

THE UTAH COPPER COMPANY.

THE ORE DEPOSITS.

This company owns about 200 acres of ground in the heart of Bingham, besides 1,000 acres near the mouth of Bingham canyon and 2,400 acres at Garfield. The ore bodies of the property in central Bingham consist of an

altered siliceous porphyry containing small grains of copper minerals, very uniformly disseminated throughout the mass, both in fracture seams and in the body of the rock. The ore averages about 2 per cent copper, 0.15 of an ounce silver, and 0.015 of an ounce of gold. The primary copper mineral is chalcopyrite, but as a result of secondary enrichment from above, practically all of the copper sulphide minerals are now present, the principal one being chalcocite. The developed area covers 72 acres of ground, and although the thickness of the ore body has not been fully determined, yet existing developments show an average depth of at least 310 feet. This area and depth of ore figures up to the equivalent of 1,000,000 tons of ore per acre. Below the depth included in the above estimate is a zone of lower grade ore averaging about 1.5 per cent copper and containing about 40,000,000 tons of ore as indicated mainly by diamond drill holes.

Besides these 72 acres now developed or partially developed, there are 88 additional acres of mineralized porphyry in the company's property that is undeveloped, although a portion of this area is known to contain ores of profitable grades.

METHODS OF MINING.

Open cut work with steam shovels was employed in the extraction of 80 per cent of the tonnage of 6,000 to 7,000 tons of ore per day, the remaining 20 per cent being taken out by the underground caving system. The caving system, although costing slightly less than 60 cents a ton of ore produced, has been abandoned completely in favor of steam shovel work. In great part the benches of ore need but little shattering by blasting, as much of the ore is already loose enough for direct shovel work.

EQUIPMENT.

At the mine the company has in operation fifteen steam locomotives, mostly of 100,000 pounds weight; 125 stripping dump cars of six yards capacity; two 40,000-pound electric

locomotives; three smaller electric locomotives and the necessary cars for underground haulage; six steam shovels; about ten miles of standard gauge railway laid with 65-pound rails; a 300 horse-power compressor plant; a completely equipped machine shop, capable of handling and repairing the heavy locomotives and steam shovel work, besides the commodious offices and quarters for employees.

About 10 per cent of the ore produced by the company is transported by the Copper Belt Railroad to the Utah Copper Company's concentrating mill at Copperton, about three miles down the canyon. This mill has a capacity of 900 tons per day. It was built originally for the purpose of developing the best process of concentration, but has been trebled in its capacity and now is an important unit in the company's commercial mills. The Mammoth concentrating mill is located at Garfield, where the company has an abundant supply of water.

ORE CONCENTRATION.

The ore is transported 15 miles northward by the Rio Grande Western Railroad Company to the Garfield mill on the shores of the Great Salt Lake, and there concentrated, 22 tons of crude ore into one ton of concentrates. The object of concentration is to get rid of the silicious waste material, which is expensive to smelt, and to collect the values into less than 5 per cent of the original tonnage. It is then only necessary to pay for the smelting of the one ton of ore instead of 20; and it costs a lower price per ton for it also, because of its higher iron content, than for the original monzonite rock with its high percentage of silica.

The process of concentration consists in crushing all the ore fine enough to sever the valuable minerals from the waste particles. With this ore it is necessary to crush everything to 40 mesh before the separation of the heavy valuable particles from the light waste material is commenced. Concentration is carried on with jigs, shaking tables and vanners, and the concentrates average 28 per cent copper, 15 per cent iron and 30 per cent silica, a very desirable smelting mixture. The

OUTCROP OF LARGE COAL VEIN.

losses in concentration, occasioned in great part by sliming, caused by the fine grinding through which all the ore is carried, are considerable, amounting to 25 to 30 per cent of the total copper. But since, under the present smelting conditions, the crude ore could not be smelted direct, concentration even with its attendant losses is absolutely necessary.

SMELTING THE CONCENTRATES.

The concentrates from the monzonite ore form a very desirable smelting mixture. It may be smelted direct in the reverberatory furnace or roasted preliminary to smelting. The fine concentrates containing high sulphur values are roasted in pot furnaces or in mechanically rabbled furnaces for the partial elimination of the sulphur. If the pot furnace is used the roasted product is in a sintered but porus condition for the copper blast furnace. Matte and slag are run from the blast furnace continually and these separate from each other by gravity in a large settler. The slag with less than .5 per cent copper is discarded, and the matter is further treated to obtain metallic copper. When the fine ore is roasted in the mechanically rabbled furnace (the McDougal) and taken out in a loose powdery condition, the reverberatory furnace is employed to smelt the roasted material. Furnaces with upwards of 2,000 square feet hearth area are employed at the Garfield Smelter on this fine, powdery material, and 350 tons of this roasted ore are run through each furnace each 24 hours. The products of the reverberatory furnaces, like the products of the blast furnaces, are slag and copper-iron matte.

The slag from both kinds of furnaces is run into large pots arranged on trucks, and transferred by locomotive on tracks to the slag dump, where it is run out in a molten state as waste.

The matte from the settler of the blast furnace or from the reverberatory furnace is run into ladles of 10 tons capacity, operated by electric traveling cranes, which span the converter house. At the Garfield works there are two such cranes, each of 60 tons capacity, which run the full length

of the converter building. The ladles of molten matte are quickly carried to the converter and the contents poured in and the ladle returned for more matte. When the converter has received its charge of ten tons the air under a pressure of 12 pounds is turned on and the shell is tilted back to position When the blow begins there is rapid oxidation of iron and sulphur. The iron having the stronger affinity for oxygen is finally all oxidized, forming with the siliceous converter lining an iron silicate slag. The slag is then skimmed and the remaining copper sulphide, after being replenished by the addition of molten sulphide of the same copper content from other converters, is again blown, to oxidize the remaining sulphur and produce metallic copper, 98 per cent pure, known as blister copper, carrying the gold and silver that were in the original ore. The bars of copper bullion cast from the converter are 24 inches long by 18 inches wide by 2 inches thick and weigh 300 pounds.

The metal is shipped away to the refineries in this crude condition. As the centers of consumption of the refined products are at a great distance from the smelting plant, and as the costs of transportation of the refined metals is much greater than that for crude bullion, no effort is made at refining the bullion in Utah.

THE BOSTON CONSOLIDATED.

THE PORPHYRY MINE.

Adjoining the Utah Copper mine on the south is the Boston Consolidated. The porphyry mine of this company covers about 156 acres of territory. A large portion of this area is underlaid by mineralized monzonite porphyry, similar to the Utah Copper ore, but running slightly lower in copper content. This ore is estimated by the company's engineers to average about 1.5 per cent copper. The capping, or overburden, to be removed in order to mine the deposit by steam shovel, is about 100 feet in thickness. The profitable ore over this area as indicated by extensive sampling and assaying, is about 300 feet deep. Very extensive equipment employed

for stripping and disposal of the capping and for the mining of ore for the concentrating mill has been in operation for three years. This equipment is said to be ample for handling 15,000 tons of rock daily.

The Boston Consolidated's concentrating mill is located at Garfield, 15 miles air line or 27 miles by railroad to the north. When all the units that are now commenced are in commission the mill will have a capacity of 3,000 tons of porphyry ore per day. At present but eight units are in operation. The concentrates are somewhat lower in copper and higher in iron than those from the adjoining property. They make a very desirable smelting material and are contracted for by the Garfield smelter on very favorable terms.

Besides the porphyry mine this company operates an extensive sulphide mine, covering 103 acres of the limestone belt. The ore, carrying a high percentage of iron pyrite, is not susceptible to concentration, but is sold to the smelter. The mine is fully equipped for the production of 750 to 1,000 tons of ore per day by square set stoping.

As the year 1909 goes out, word comes that there has been a consolidation effected between the Utah Copper and the Boston Consolidated companies. To an observer this certainly sounds like a step toward conservation. As the benches of the Utah Copper ore advance toward the Boston Consolidated's ground by the steam shovel mining, there must come a time when the latter company's property will be seriously interfered with, or when the former must give up open-cut working, as the Boston Consolidated's claims are directly up the mountain above Utah Copper ground. The consolidation will make it possible to cave even more ground from the lower benches and thus decrease costs of extracting the ore of this wonderful mountain.

THE OHIO COPPER COMPANY.

DISSEMINATED QUARTZITE.

This property adjoins the Utah Copper on the east and the Boston Consolidated on the north, and covers an area of 120 acres. The ore is quartzite, mineralized with copper and iron sulphides. The quartzite merges into the laccolithic mass of monzonite porphry of the two adjoining properties. The ore is much shattered and broken. Disseminated throughout the shattered rock, and especially along the cleavage planes is the copper ore in the form of a clean chalcocite, associated with chalcopyrite and pyrite. Many crevices in the shattered quartzite have been filled by the metalliferous minerals forming stringers and veinlets of rich copper sulphide.

Larger fissure veins traverse the deposit and these contain much ore of higher copper content, due to secondary enrichment. In these veins, along with the predominant chalcocite, there is found much red oxide as well as some melic copper.

From careful and conservative calculation of ore reserves there is estimated to be 13,500,000 tons of ore in the mine above the present transportation tunnel. The average copper content of the ore, as obtained from abundant sampling, is 1.6 to 1.75 per cent copper, with some 10 cents in gold and 3 cents in silver per ton.

The concentration of this ore is a simple matter, as the copper minerals are not so finely disseminated through the rock as they are in the porphyry of the neighboring properties. The absence of any clay or talcy decomposition products of the rock make this quartzite an exceedingly favorable ore for concentrating. The mill tests have given an extraction of 75 to 80 per cent of the values.

A concentrating plant of 2,400 tons per day capacity is now built at Lark, three miles to the east, for treating this quartzite. Two sections of the mill are now in operation. The main features of difference between this plant and those of Utah Copper and Boston Consolidated plants are due to the

difference in the ores. This mill will crush all ore to 12 mesh only, and will make its principal savings with the copper minerals in larger pieces, using jigs and shaking tables, but no vanners. It has, however, provided a slime plant, with settling tanks, slime tables and buddles. The ore is extracted by the caving system and dropped through winzes to the ore bins, 400 feet long, built 1,000 feet underground, just above the transportation tunnel, which reaches the property 1,000 feet below the bottom of Bingham canyon. This tunnel runs eastward 13,000 feet to daylight on the east base of the Oquirrh mountains, where the concentrating mill is located. The ore is transported at a cost of 15 cents per ton, mined for 50 cents and concentrated for 50 cents per ton. With copper at 15 cents, the net income per day on 2,400 tons of ore is estimated at $3,864, or an income of $1,400,000 per year.

The company has built the present mill with the idea of enlarging its capacity to 4,000 tons per day in the future.

THE UTAH CONSOLIDATED.

The Highland Boy mine of the Utah Consolidated Company was one of the early producers of the high grade sulphide ores. The ores of this company were smelted for a number of years at their own smelter at Murray, Salt Lake county. The ore averaged high in copper and the output of the smelter in copper bullion was large for the ore tonnage treated. The high grade ore and the favorable conditions of mining and smelting were indicated by the dividends disbursed. These amounted to more than one million dollars per year. Since the closing of the Murray plant by the injunction by the farmers of the valley, the ore has been treated by the American Smelting and Refining Company's plant at Garfield.

The Utah Consolidated has let a contract for smelting its ore for the next ten years to the International Smelting Company, who are building a modern copper smelter at Pine Canyon, just over the Oquirrh range to the west, in Tooele county. The smelter is to be ready to treat the ores of the

company by April, 1910. The mining company, in the meantime, are constructing an aerial tramway from the mine over the mountain range and down Pine canyon to the smelter, a distance of six miles. Eight hundred to 1,000 tons of ore per day will be transported from the mine over this aerial tramway when completed.

THE YAMPA MINE AND SMELTER.

One of the large producers of the sulphide ores of Bingham is the Yampa mine. The ore is practically self-fluxing with the exception of needing a small amount of limestone. The mine is now putting out a tonnage of 700 to 800 tons of ore per day which is transported about one and one-half miles to the Yampa smelter, in Bingham canyon, the cost of transportation being 7 cents per ton.

The smelter treats the total tonnage of the mine, besides about 200 tons daily of custom ore. The furnaces of the plant consists of nine McDougal roasters, three reverberatory furnaces, two having dimensions of 17 feet by 55 feet, and one 17 feet by 45 feet; three blast furnaces, two 42 by 160 inches and one 42 by 184 inches; two converter stands, with six converter shells of 84 by 136 inches dimensions. The production of metallic copper by the Yampa smelter with its present capacity is slightly over 10,000,000 pounds per year.

THE UNITED STATES PROPERTIES.

The extensive properties of Bingham canyon owned by the United States Mining Company are producing a large output that is all smelted at the United States smelter at Bingham Junction, in Salt Lake county. Their ores are transported by aerial tramway to the Rio Grande Western Railroad cars at the Bingham terminus and then hauled to the smelter, 12 miles away.

The properties described are the most important in Bingham from the standpoint of present development. Nevertheless, there are many other important producers of copper as

well as of lead ore in the West Mountain district, in which Bingham is situated.

THE TINTIC DISTRICT.

Tintic has achieved and still holds the enviable distinction of having more dividend paying mines than any other district in Utah. Eighteen of her mines are credited with having paid dividends of $17,000,000. The exact figures of bread money distributed are hard to ascertain, as many of the mines have been operated by individuals and close corporations, concerning whose income the public has learned little or nothing.

The Centennial Eureka, one of the richest mines of the United States Smelting, Refining and Mining Company, has of late years been the heaviest shipper. The Bullion Beck, one of the oldest producers of the district, has recently gone into the hands of the United States Company, and will be exploited even more actively in the future. The Eureka Hill leasers have been very active during recent years and have produced large quantities of good grade ore. The Mammoth and Grand Central seem to show no limit to the depth at which they obtain very profitable ore.

East Tintic, around Godiva mountain, has shown greatest activity during the last two years. The May Day and Uncle Sam have both benefited by the union they effected during 1907. During 1908 there have already been paid out by these companies near $150,000 in dividends. The Knight properties, consisting in the main of the Colorado, Beck Tunnel, Black Jack, Crown Point and Iron Blossom, controlled by Mr. Jesse Knight of Provo, Utah, have made a phenomenal record since their exploitation commenced some three years ago. The Colorado has taken the lead by producing nearly a million dollars' worth of ore in 1907 and paying an aggregate of nearly $800,000 in dividends during that year. Her ore averages from $75 to $100 per ton in lead, silver and gold. The Beck Tunnel has been a close follower with ore values averaging somewhat less, but with a total dividend record near the $700,000 mark, but distributed over a considerably

longer period of time. As evidenced by the miniature dumps at the shafts of these two mines, there has been very little dead work. Practically everything taken out has been shipping ore. This lime formation of East Tintic has responded so abundantly to the efforts of the miner that now a circle of dividend paying mines is found around Godiva mountain, including the above mentioned properties, the Yankee Consolidated, the Gemini, the Giroux Consolidated and some others.

PARK CITY.

Owing to the recent very unfavorable metal market this lead and silver camp, during the last two years, marketed less ore than usual. But during this period much development work was done, which opened up ore bodies that make it possible for some of the largest companies to ship, when metal prices improve, even better ore and larger tonnage than ever before. Little stir is made as the development opens up new bonanzas, but that such are opened up is always shown as the metal market warrants big tonnages. The persistence of the rich ore in the Park City mines as depth increases makes it important to provide proper drainage. The Ontario drain tunnel, three miles long, was constructed for this purpose.

The caving in of this drain tunnel a few years ago caused the lower levels of some of the large mines to become flooded. By intelligent and untiring effort this tunnel has, during the last year, been again opened. It has also been extended back under the Daly and Daly West mines. The tunnel will cut the Daly West shaft at the 2,100-foot level, giving this mine 600 feet additional vertical depth. The Daly West main shaft is being deepened to meet the tunnel and is now near the 1,700-foot level.

The Silver King mine has made important strikes of high grade ore during recent developments that put it in possibly better condition than ever before. It, with the Daly Judge and Daly West, is shipping fair tonnage at present.

The new developments of the Park City district have been made recently in Thaynes canyon, toward Brighton.

Prospects that are showing great activity there are the Copper Apex, Keystone, Uintah Treasure Hill, New York, Wabash and Silver King Consolidated.

MERCUR.

Utah's famous gold producer, the Consolidated Mercur Gold Mines Company, is the leading gold producer in the state. During the past fifteen years there have been many millions in gold produced by the properties of this company. The total dividends to date paid by the present company and by the old De La Mar and Mercur Companies run up to the handsome sum of $3,385,312.97. This amount shows the success that has attended the persistent efforts of Mr. John Dern and his associates.

The ore was early known to contain gold, although the prospector was unable to even get colors by the use of the gold pan, and the prospector often had difficulty in interesting the investor in the properties of the camp because no gold showed up in the pan. Mr. Dern and his associates from Nebraska took hold of much of this ground, but found great difficulty in extracting the gold values. The ore refused to give up its wealth by any metallurgical methods, although the owners systematically and persistently experimented with all the commercial methods of extraction then known. At that time the cyanide process was just being developed and the Mercur operators quickly took up with this new process and had their ore carefully tested. The results showed but meager success at first. The oxidized ore gave fair extraction, but much of their higher grade sulphide ores gave little promise of ever responding. By careful work with the roasting furnace under the efficient direction of Mr. D. C. Jackling, now general manager of the Utah Copper Company, the sulphide and arsenide ores were brought into a condition for effective cyaniding. Still another difficulty remained to be solved. The slimes were large in amount and no method for successfully treating them had been perfected. This problem the present owners have solved, and the tailings of sands and slimes now carry over

the dump but slightly over 50 cents in gold per ton. The Consolidated Mercur mill has a capacity of 800 tons per day, and the Holderman Filter Tank Company is now operating by sliming and vaccuum filtering at a daily tonnage of 200 tons on the Manning dump of the early Mercur tailings.

The Boston-Sunshine Gold Mining Company have reconstructed the mill of the old Sunshine mine ot Mercur and are adding much new equipment preparatory to cyaniding the very clayey refractory ores of the once famous Sunshine mine. The mill will have a capacity of 200 tons per day and was put into commission during the month of April, 1909.

Time will not permit of more than passing mention of other important mining districts of the State. Alta, Big Cottonwood, American Fork, Deep Creek, Beaver County, Kimberley, Park Valley, Gold Springs and others have produced much ore to increase the yearly output of the state.

SALT LAKE CITY AS A SMELTING CENTER.

Salt Lake City is at present the most important smelting center in the world. The tremendous ore supply of the three great mining camps so near at hand, namely, Bingham, Park City and Tintic, giving a combination of easily smelted mixtures, and the unlimited confidence in the continuance of the supply, has justified the building of exceedingly large smelting plants in Salt Lake valley. The favorable position of Salt Lake as a railroad center enables the smelters to draw large supplies of ore from all parts of Utah, from Idaho and even from California.

With the galena and lead carbonate ores from Park City, Tintic, the Cottonwoods, from Idaho and Nevada; the copper iron sulphides of Bingham and Beaver county, the siliceous copper, gold and silver ores of Tintic and scattered camps, and from Nevada, the ore supply is more diversified than anywhere else in the United States. Large custom copper smelters and lead smelters, with their competition for custom work, have brought very favorable smelting rates to the ore producer. Nowhere else in this country can the producer dispose of his ores at so favorable figures.

The smelters now in operation, with their capacities, are as follows:

		Tons Daily
Murray Plant, American Smelting and Refining Co.	lead	1,500
Garfield Plant, American Smelting and Refining Co.	copper	3,000
United States Smelting Company, Bingham Junction.	copper	1,500
United States Smelting Company, Bingham Junction.	lead	1,000
Yampa Smelter, Bingham Canyon	copper	1,000
Utah Smelting Company, Ogden	copper	250
Tintic Smelting Company, Tintic	lead	350
Tintic Smelting Company, Tintic	copper	150
Total Capacity Daily		8,750

SMELTER SMOKE.

The decision of United States District Judge Marshall in favor of the farmers of Salt Lake county against the smelters of Murray and Bingham Junction, whereby the smelters were not allowed to smelt or roast any ore containing over 10 per cent sulphur, seemed a severe blow to the smelters. The decision did not affect the plants at Garfield or Bingham canyon. Two of the smelter companies abandoned their plants. These were the Highland Boy and Bingham Consolidated copper smelters. The former immediately took options on land about 20 miles west, just over the Oquirrh mountains, in Tooele county, and the latter negotiated for land somewhat farther west.

The American Smelting and Refining Company came to an agreement with the farmers, whereby they would remain at Murray, by installing a bag house to filter all solids from their smoke, and by instituting some minor changes.

The United States Smelting Company, as a result of untiring experiments with its smoke to determine a method of abating the nuisance, apparently succeeded, and now are able to run all the smoke, not only from their lead furnaces, but also from their copper furnaces, through bags, and collect all solid particles. As a result of this success they have been given opportunity to resume their entire plant and continue so long as no bad effects are suffered by the farms. The company seems to have perfect confidence that they shall be able to go on in the future undisturbed, for they are remodeling

their plant and increasing the capacity of their bag house at a very great expense. It is anticipated that no further trouble will ensue between smelter and farmer.

UTAH'S IRON WEALTH.

The Iron Springs district lies between longitudes 113 deg. 10 min. and 113 deg. 26 min. 30 sec., and latitude 37 deg. 35 min., 37 deg. 47 min. 30 sec., in Iron county, southern Utah, about 250 miles south of Salt Lake City and 550 miles from the harbor of San Pedro, Cal., on the Pacific Ocean. The San Pedro, Los Angeles and Salt Lake Railroad runs within 22 miles of the district on the west, Lund being the nearest station. The district can also be reached by way of a spur of the Denver and Rio Grande Railroad running down to Marysvale, 80 miles northeast of the district, thence on by stage.

The elevation ranges from 5,300 to 8,000 feet.

The drainage is through small creeks leaving the mountains and hills and soon losing themselves in the desert.

The tops of the Harmony Mountains retain snow until the middle of summer, and consequently have an abundance of vegetation, such as yellow pine, fir, cottonwood, quaking aspen, and mountain mahogany. The tops and slopes of the other mountains are dry and are covered with a growth of scrub cedar and pinon. Shrubs, sagebrush, and several species of cacti are also aboundant, but grasses are lacking. The surrounding desert presents the variety of sagebrush, rabbit brush, greasewood, and shad scale characteristic of the desert elsewhere in the Great Basin.

DESCRIPTION OF THE IRON ORES.

The iron ores occur in disconnected masses within a general area about 1½ miles wide by 20 miles long, running northeast and southwest. They lie for the most part on eastern and southern slopes or foothills of The Three Peaks, Granite Mountain, and Iron Mountain, between elevations 5,600 and 6,700 feet, but some of them, as on Iron Mountain, appear at or

near the tops of the mountains at elevations between 7,000 and 8,000 feet.

Some of the iron-ore exposures stand out as much as 200 feet above the surrounding country as black, jagged ridges. Others, including several of the larger deposits on the lower slopes, do not stand above the surrounding rocks, but are known by isolated exposures and black iron-formation fragments disseminated in the loose detrital material at the surface. Some of the ore does not appear at the surface at all, being covered by andesite detritus woshed from the upper slopes, though, even here, fragments of ore are likely to appear in the detritus farther down the slopes. In such places the exact shape and distribution of the deposits can not be determined without trenching or pitting. Fortunately such work will suffice fairly well throughout the possible, ore-bearing areas though there are places where areal extensions of iron-ore belts may be found by underground exploration, or where belts, mapped as continuous on the basis of the surface fragments, may really be discontinuous. The deepest pits in the district, 130 feet, have not yet reached water level.

KINDS AND GRADES OF ORE.

The following description applies to the ores as they appear above water level. Pits have not yet been sunk below this depth.

The ore is mainly magnetite and hematite, usually intimately intermixed, but locally segregated. So far as present information goes (and it does not go far below the surface) the magnetite constitutes about 70 per cent and the hematite 30 per cent of the whole. As hematite appears more abundantly below the surface, it is thought likely that deeper exploration will develop a higher percentage of hematite. At the surface the ore is ordinarily hard crystalline magnetite and hematite in porous, gnarled, and contorted masses, with coarsely crystallized quartz and fibrous chalcedony as the principal gangue mineral, filling, wholly or partly, cavities in the ore. Other gangue minerals occuring in small and practically negligible amounts are apatite, mica, siderite, diopside, garnet, pyrite,

chlorite, calcite, barite, galena, amphibole, copper carbonates, limonite, and amethyst. Of these minerals barite and galena are more closely associated with the limestone than with the ore. Melanterite, associated with pyrite, was found in process of formation in the long tunnel on the Duncan claim. Beneath the surface the ore is usually softer and contains a larger proportion of soft, bluish, reddish, brownish, grayish, and greenish banded hematite, limonite, and magnetite in greatly varying proportions and relations. The gangue materials are more abundant than near the surface, and calcite is in relatively increased proportion as compared with the quartz. The banding in the contact ores partly represents the bedding of the limestone, which, as will be shown later, the ore replaces. Banding in the dike or vein ores in the andesite is of unknown origin, possibly the result of original deposition. Some of the softer ore at lower levels entirely lacks this banding. Locally, as on the west side of Lindsay Hill, the contact ore contains parallel streaks of a yellow clayey-looking material. On examination this resolves itself into a mixture of iron carbonate, iron sulphate, and glass, and probably some residual clay. Some of the narrow ore veins in the andesite possess a comb structure formed by the meeting and interlocking of apatite crystals projected from the walls sometimes not entirely closing the vein.

In the ore breccias the cements are magnetite, limonite, calcite, and quartz. At the Milner mine and elsewhere the magnetite has been deposited first about the fragments, here consisting of quartzite, then hematite, then limonite, but exceptionally in the same locality the reverse order appears.

The texture of the ore as a whole is good for furnace use. The harder ores will need crushing.

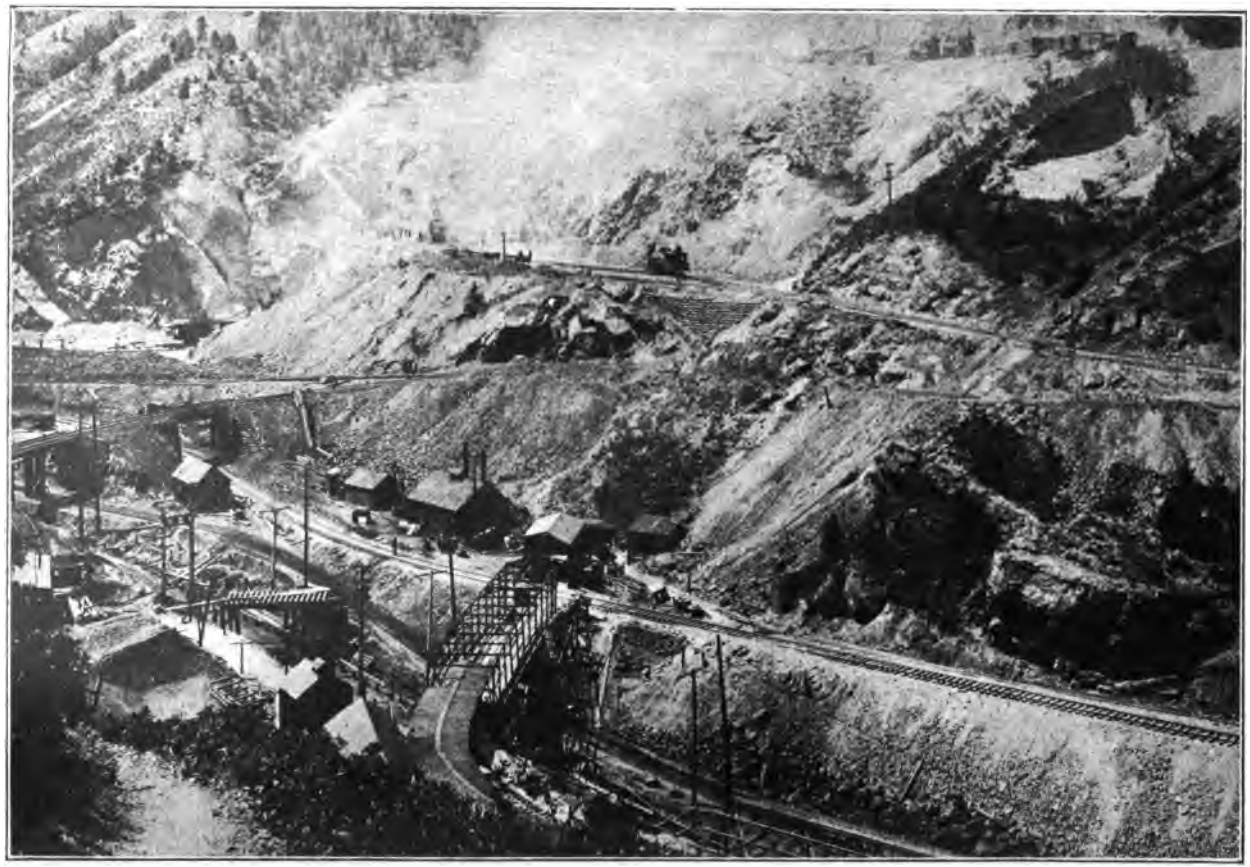
	Iron Springs ores.	Lake Superior ores.	Alabama hematites.
Iron (metallic)	56	59.6	37
Silica	7	7.5	13.44
Phosphorus	.200	.067	.37
Lime and magnesia	4	1.3	16.2
Alumina	1	1.5	3.18
Water, above 220 deg.	3	4.0	.50
Copper	.027		
Sulphur	.057	.019	.07
Manganese	.196		
Carbonic acid			12.24

It will be noted that the Iron Springs ores are intermediate in composition between the two other great classes of ores.

SIZE AND QUANTITY OF ORE DEPOSITS.

The iron-ore deposits vary from mere stringers to those having an area of 1,670,000 square feet. The aggregate surface of all the ore deposits of the district is 5,430,000 square feet or 0.2 square miles.

The aggregate tonnage of all grades of ore in the district, determined by multiplying the known area by the best available information as to depth in pits, drill holes, and erosion sections is 40,000,000 tons. The largest single deposit, figured on the same basis, has 15,600,000 tons. It is altogether likely that the figures are much too small rather than too large, because the depths used in the calculation have been those actually observed, and observation has not yet gone to the bottom.



OPEN CUT MINING AND SWITCHBACK TRACKS IN UTAH COPPER MINES AT BINGHAM.

UTAH'S STEADY ADVANCE.

Utah's prominence as a mining state has been gained gradually as a result of the extensive development of enormous medium and low grade deposits. There have been no spasmodic and temporary gains in her metallic output, neither have there been serious losses, as the years of prosperity or adversity in mining arrived. No decline in lead and silver or slump in copper has caused collapse. Her advance has been rapid but regular. The prospects are brighter now for increased output in future years than they ever were before.

The dividends from her mines and smelters indicate the substantial nature of these industries. For 1907 the reported dividends amounted to more than $5,000,000, and this was no exception, as the bread money distributed for a number of years has hovered around this flattering figure.

SECURITY OF INVESTMENTS IN UTAH.

There have been fewer labor troubles in Utah than in any mining state in the West. Seldom have the mining and metallurgical operations in the state been interfered with by conflicts between capital and labor. The sentiment of the people of Utah is against strikes and lockouts. Laborers have never demanded exorbitant wages. Mine and smelter managers have acceded to the request for increased pay during especially prosperous years, and the workmen have allowed this increase to be taken off at times of depression. Capitalists are now appreciating this favorable relation between capital and labor in Utah, and are showing a preference for our state as a place to invest their money.

During the years 1874 to 1876 a small furnace, with a daily capacity of 5 tons, was built and operated at Iron City, 5 miles southwest of Iron Mountain. The product was taken to the then prosperous silver mining camp at Pioche, Nev., and to Salt Lake, Utah. Later the old stack was torn down and a new one, projected to take its place, never rose higher than the foundation. The coal was derived from the Harmony Mountains, 5 miles to the southeast. The ore used in this furnace

was taken out of the Duncan claim, one of the southernmost exposures of ore in the Pinto groups of claims, from shallow pits and short tunnels near the surface.

From time to time since the discovery of the deposits, pits and tunnels have been sunk in the ore, principally to meet assessment requirements, but partly to show up the ore bodies. Some of the more vigorous exploration was conducted during the years 1902 and 1903. The total number of pits sunk to date has been approximately 1,600, of which 30 have gone to a depth greater than 50 feet. The maximum depth has been 130 feet.

COAL.

The estimated coal area of Utah is 13,130 square miles, with an additional 2000 square miles that may contain workable coal seams, divided into three coal regions; the Uintah region, embracing Carbon, Emery, Grand, and Uintah counties on the East; Southwestern Utah region, embracing Iron, Kane, Washington, Beaver, and San Juan counties on the south; Weber region, embracing Summit and Morgan counties on the north.

The estimated tonnage in these three regions, easily accessible and accessible with difficulty, is 196,458,000,000 tons; the total approximate amount of coal extracted from the Utah coal fields is 28,000,000 tons.

Carbon county takes the lead of counties in coal production, and up to the present time has furnished more than 90 per cent of the entire coal output of the State.

In this county are the Sunnyside coal mines, with an output of 2000 tons per day, which can readily be increaed to 3500 tons per day. Here are located some 640 coke ovens, producing a high grade of coke, all of which product is used in the Utah, Nevada, and California smelters.

The coal measures at these mines are from five to eleven feet thick; the Clear Creek mines Nos. 1 and 2, with an output of 2200 tons per day, vein eleven feet thick; Winter Quarters mine, output 1800 tons per day, vein twelve to sixteen feet in thickness; Castle Gate mines, output 1200 tons per day,

working three veins, from four to eleven feet in thickness. There are 204 coke ovens at this mine. These are all owned and operated by the Utah Fuel Co., and are equipped with electric haulage.

Pleasant Valley mines, Nos. 1 and 2 with an output of 1800 tons per day, two veins, one 26 feet in thickness, the upper vein 9 feet in thickness, operated by the Union Pacific Coal Co.

Kenilworth mines Nos. 1 and 2, output 900 tons per day. These are new mines, not fully developed. Two veins are being worked. The lower vein is 22 feet, and the middle vein 9 feet thick. These mines are owned and operated by the Independent Coal and Coke Co.

The Consolidated Fuel Company is developing mines in Miller Creek, on the southwest edge of Carbon county, and have the grading done, two bridges in and some five miles of rails laid on the Utah Southern railroad, that is being built from the Denver & Rio Grande railroad at Price, some twenty miles to the mines. These mines will be opened on two veins of coal, one twenty feet and the other 6-6 feet in thickness.

The People's Coal and Coke Company at Hales is working a small force of men, developing a four-foot vein. Drilling for a lower vein is being done by Gomer Thomas and associates in Hales Canyon.

The Utah Collieries Company has recently been organized to operate a six-foot vein of coal near Scofield.

A company headed by Mr. Frank Cameron is opening up a vein of coal in Panther Canyon, into the same vein worked by the Independent Coal and Coke Company. They are also constructing an 8000-foot tramroad to connect their mine with the Denver and Rio Grand railroad between Castle Gate and Helper. There are eight other small mines that supply the local trade in the winter months, that are not connected with a railroad.

The mines worked in Carbon county are all working practically the same veins which has been demonstrated to be the best and most expensive body of coal in the West for steam, coke, and domestic purposes, being clean, hard, bituminous coal.

These coals are situated in the Laramie formation of the Cretaceous Age, and underlay practically the whole country.

Emery county, like Carbon county, has large deposits of coal, but being remote from railroad connections only small mines to supply local trade have been worked.

The Castle Valley Coal Company has been organized by Salt Lake and eastern parties to open up a large body of coal situated in Cedar Creek Canyon. A spur some eight miles in length will be run from the Utah Southern railroad to Cedar Creek Canyon, connecting at Price with the Denver and Rio Grande railroad. There are five veins of coal on the Cedar Creek Canyon property from five to twenty-five feet in thickness. The coal is of the same age and formation as that in Carbon county.

There are some forty coal openings on the veins in this county, where the coal is mined in winter time to supply coal for family trade. Reports have been made from time to time that much of the coal in this county can be made into coke. But a small per cent of this coal has been filed on or acquired.

In Uintah county, there are eight small coal mines in operation. This vein is six feet thick, and by geologists is listed in the Colorado age. The present operations are some six miles west of Vernal, with a total yearly output of two thousand tons. The area of the coal field in this district covers some ten square miles, and not more than four hundred acres have been secured. This coal is of a sub-bituminous grade.

Grand county has a large area of coal, but is practically unprospected. One opening near Thompson's Springs has been made, from which opening some coal is hauled to Moab for winter use.

The Uintah region contains a total of 9,900 square miles of workable coal.

The southwestern Utah region, containing 3000 square miles of coal land, is practically untouched. These coals occur in the Colorado group, and the nearest railroad point is the Salt Lake, San Pedro and Los Angeles railroad at Lund, some thirty-five miles from the coal cropping in Coal Creek, just east of Cedar City, Iron county.

There are a number of openings on the vein in Iron county, which averages five feet six inches in thickness, from which winter coal for nearby settlement is secured, each claim or filing averaging sixty acres each.

There is the Jones & Bullock, the Cluff, Wood & Taylor, all in Coal Creek Canyon, Leyson, Lunt, Corry, Culver, and Kanarraville mines on the Colob Plateau between Cedar City and Kanarraville.

There is an area of semi-anthracite about four miles from New Harmony in Washington county, that is owned by Los Angeles capitalists who are trying to organize a company to build a railroad from the Salt Lake, San Pedro and Los Angeles railroad to their property at New Harmony. A fair grade of cannel coal has been found on the Virgin river in this region, the vein running about seven feet in thickness. In fact, but little is known of the mineral resources of this region.

The Weber region embraces some forty square miles, and belongs to the Colorado age. This coal is a sub-bituminous grade, well adapted for steam and domestic uses. There are two veins of coal, averaging nine and four feet. Four mines are being worked in this region, three in Summit county and one in Morgan county. The principal mines in Summit county are the Wasatch and Grass Creek mines.

The Wasatch or Weber mine is owned and operated by the Weber Coal Company, which is a part of the Ontario Mining & Milling Company, of Park City. This mine is located about two miles northeast of Coalville, and is working a vein of ten feet in thickness. The output of the mine is about 300 tons per day. This property is composed of some two hundred acres of coal land.

The Rees-Grass Creek Coal Company is developing a mine one mile west of the Union Fuel Company on a lease from the Union Pacific Coal Company. The output is about one hundred tons per day. The market for the Weber region coal is mainly Park City, and the cement plant located at Devil's Slide.

The upper, or small vein of this district is not being worked. Several openings have been made, and the coal proves to be of a fair quality, but the size of the vein is against

it, when it comes in competition with the larger vein.

The Utah Steam Coal Company's mine, known as the Dexter mine, situated two miles southeast of Coalville, is not at present in operation.

The output for last year was two hundred tons. The Superior Fuel Company has been recently organized to take over this and adjoining properties for the manufacture of briquettes. This company has been organized by Kansas City and Utah capitalists. The Lost Creek mine in Morgan County owns eighty acres of coal land and is operated by W. H. Robinson of Morgan. This coal has not been developed, though small openings have been made to extract coal for winter use. Only two hundred tons were mined last year.

Sanpete County has three small mines in operation during the winter months: The Cove Creek Coal Company, located at Sterling. The property shipped 1,500 tons last year. The Wales mine situated at Wales, operated by H. L. Thomas, mined 275 tons last year for local use.

The Utah coals are of excellent quality as is indicated by the following analyses:

Carbon County.

Moisture	3.20
Volatile Matter	45.67
Fixed Carbon	47.22
Ash	3.35
Sulphur	0.56
Total	100.00

Scofield.

Moisture	5.00
Volatile Matter	45.37
Fixed Carbon	45.23
Ash	4.40
Total	100.00
Sulphur	.73

Clear Creek.

Moisture	3.42
Volatile Matter	43.56
Fixed Carbon	48.38
Ash	4.64
Total	100.00
Sulphur	.68

Castle Gate.

Moisture	1.68
Volatile Matter	44.29
Fixed Carbon	48.65
Ash	5.38
Total	100.00
Sulphur	.47

Sunnyside.

Moisture	.98
Volatile Matter	39.54
Fixed Carbon	57.84
Ash	1.64
Total	100.00
Sulphur	.55

COAL PRODUCTION IN UTAH FROM 1876 TO 1908 INCLUSIVE.

YEAR.	Tons Produced	GAIN	LOSS.
1876	50,400	.....	.....
1877	50,400	.....	.....
1878	67,200	16,800	.....
1879	225,000	157,800	.....
1880	225,800	800	.....
1881	250,000	25,000	.....
1882	250,000	.....	.....
1883	250,000	.....	.....
1884	250,000	.....	.....
1885	213,120	.....	36,880
1886	200,000	.....	13,120
1887	180,020	.....	19,980
1888	259,501	.....	.....
1889	236,651	79,500	22,850
1890	318,159		.....
1891	371,045	81,505	.....
1892	361,314	52,886	9,731
1893	418,049	.....	.....
1894	447,276	56,735	.....
1895	172,958	59,227	274,328
1896	503,243	.....	.....
1897	582,092	330,285	.....
1898	673,297	78,849	.....
1899	878,122	91,205	.....
1900	1,233,978	204,826	.....
1901	1,382,470	456,856	.....
1902	1,641,436	148,492	.....
1903	1,782,178	258,966	.....
1904	1,563,274	120,742	218,904
1905	1,602,528	39,350	.....
1906	1,839,219	236,691	.....
1907	1,967,651	128,432	.....
1908	1,844,849	.....	122,808

NONMETALIC MINERALS.

SALT.

There has recently been explored a most important salt deposit in the form of an immense salt bed in the Great American desert, about 110 miles west of Salt Lake City, and 15 miles east of the Utah-Nevada state line. The Western Pacific Railroad has built its track directly through these beds. This salt covers an area of 60 square miles. The deposit varies in depth from six inches to seven feet or more, in places where poles were set. It is almost perfectly white and absolutely free from dirt, rubbish or growth of any nature. Providing the deposit only averages one foot thick, the amount of salt to the square mile will amount to more than one million tons, or sixty millions of tons in the whole deposit.

The United States Congress, by the provisions of the Enabling Act for Utah, gave to the University of Utah all saline lands of the state. Notwithstanding this fact, prospectors have staked out their claims over the deposit and are contesting their rights in the courts. The Supreme Court of Utah, recently, gave its decision in favor of the State University, but the case may not be finally disposed of until the United States Supreme Court gives its decision. With this immense deposit of pure mineral as an asset the University will be well provided for as the market develops.

There are billions of tons of salt in the waters of Great Salt Lake, and extensive deposits of rock salt in the mountains of the state. From these sources the state is producing yearly about thirty-five thousand tons. With the increased facilities for transportation now promised by the advent of the numerous railroads throughout the state, this output can readily be increased, in the near future, many fold.

The Inland Crystal Salt Company of Salt Lake City, is harvesting almost the entire salt output of the state from the waters of the Great Salt Lake. Their works are located near the famous Saltair resort. The water of the lake is pumped by centrifugal pumps into shallow pounds, where solar evap-

oration in the dry summer months carries off the water, leaving the crystal salt behind. The evaporating season lasts about one hundred days, during which time there is constant pumping of the brine into the pounds, the aim being to keep the evaporated solution from becoming so concentrated as to deposit other solid matter with the crystals of sodium chloride. When the season is over, the mother liquor is flushed out of the pounds, leaving a layer of soft crystals from three to six inches deep, covering the entire area of the shallow ponds. An average crop is four and one-half inches thick, amounting to 700 tons of salt per acre. Each pond has been previously lined with a thin deposit of salt by this same process, and the salt lining has become very densely caked, so as to form a firm bottom to the regular salt crop.

Thus the crop can be readily shoveled up into windrows and from here into cars and barrels, and then dumped into piles of about one thousand tons each. These piles soon become covered with a very hard crust. The outer layer partly dissolves with the rains, and the crystals become cemented together very firmly around the outside of the pile. These piles may be left with safety for years, if need be.

Much of this crude salt found a market in the past for chloridizing, roasting and leaching of ores. At present there is little call for salt for these purposes, but with the advance of metallurgical experimentation on wet methods, there seems to be promise of a revival of wet methods, wherein much sodium chloride will be required.

UTAH HYDROCARBONS.

The chief hydrocarbon field of the state is the Uintah Basin, in eastern Utah, with an area 170 miles long by 100 miles wide. This basin is bounded on the north by the Uintah range of mountains, on the south by the Book Cliffs, and on the east by the Danforth Hills and Yampa Plateau. The general elevation of the basin is five to six thousand feet. The whole of the formation of the Uintah basin is of sedimentary origin of the Eocene-Tertiary period. The hydro-carbons occur as

true veins, that is, as fillings of fissures which cut through the sandstones of the region. These veins range from one to twenty feet in thickness, of solid gilsonite or Uintahite, as it is called. The depth to which these veins extend is not known as they have not been fully prospected and no workings have yet reached their lower limit. At one point on the White river the vein is seen to be 3000 feet deep.

Much of the limited amount of work of extracting the black hydro-carbon material has been done by open cut methods of mining, as it was considered dangerous to use underground methods and employ the ordinary candles or lamps of the coal mines in the work. Of late years electricity has been brought to the mines, and now considerable exploiting is being done by regular underground methods, using the incandescent lamp for lighting. The vein substance is in most instances pure gilsonite with almost no pieces of wall rock or other impurity contaminating it. It has but to be loosened by picks, and shoveled into sacks, then taken to the surface readly for shipping.

This mineral brings a price of $40 to $45 per ton.

ABUNDANCE OF GRAPHITE.

A very superior quality of graphite is found at Perry, Utah, about five miles south of Brigham City, Boxelder county. Mr. Hoyt S. Gale, of the United States Geological survey, recently made a careful examination of this deposit, and said that it is the best deposit of graphite in the United States.

This country produces but one-half of the graphite it consumes, hence the importance of this valuable discovery. A well developed ledge 27 feet wide and 4,000 feet long is in sight. Tests have proven an average of 90 per cent pure graphite, and running as high as 98 per cent. The development of this property and the manufacture of the product means much to the State, if the manufacture can be kept within the State. It is one of the industries that merit the support of home capital. Mr. A. S. Burrit of Salt Lake City, is president of the company owning the property.

GILSONITE DEPOSITS.

(From the Mountain Empire.)

Of the hydro-carbons occurring in the Uintah Basin, and in Utah as a whole, by all means the most important under present conditions is uintaite, heretofore specified as the gilsonite of commerce and trade. This mineral is a black substance, of brilliant luster and conchoidal fracture, suggestive of solidified pitch. On exposure it loses its brilliant luster and becomes dead black, but the change ordinarily extends to an insignificant depth only.

In the vein the mineral is of columnar structure, the long axes of the columns being at right angles to the inclosing walls, thus indicating a heated injuncture subsequently cooled.

Uintaite (gilsonite) occurs as true veins, that is, as fillings of fissures which cut through the sedimentary formation of the region. In one sense these veins should be regarded as dykes, inasmuch as the filling has resulted from injection of material in a molten or plastic state, and not by slow deposition from solutions. It is not within the scope of the present article to discuss the probable mode of deposit, or to deal with the theories of origin of these occurrences, however interesting and attractive such a topic may be. The fact is that we find within the Uintah Basin true veins or fillings of pre-existing fissures, the contents of which are hydro-carbons of value and use. Of these deposits uintaite (gilsonite) is in such demand that it can be mined, sacked and shipped at a profit, in the face of strenuous competition in Eastern markets.

Chemical analysis shows typical uintaite to consist of:

Volatile matter	56.46%
Fixed residue	43.43
Ash	.10
	99.99

Ultimate analysis reveals as the components:

Carbon	98.30
Hydrogen	9.96
Sulphur	1.32
Ash	.10
Oxygen and Nitrogen (undertermined)	.32
	100.00

While uintaite (gilsonite) as it occurs in nature is brittle, by proper treatment it becomes sufficiently coherent to serve as the chief ingredient in prepared varnishes and japans. For these purposes it is heated with linseed oil and thinned with turpentine. The uses of the material, as enumerated in the United States Government reports, are as follows:

For coating ship bottoms to prevent electrolytic action; for coating barb wire fences, etc., for coating sea-walls of brick or masonry; for covering paving brick; for acid-proof lining of chemical tanks; for roofing pitch; for insulating electric wires, for smokestack paint; for lubricants of machinery; for preserving iron pipes from corrosion and acids; for coating poles, posts and ties; for teredo-proof pile coating; for covering wood-block paving; for the manufacture of cotton garden hose, as a substitute for rubber; for the manufacture of briquette and compressed coal slack, as a binder pitch.

It is generally known that the principal supplies of hydrocarbon minerals for use in the United States are derived from Trinidad. Water transportation is so much cheaper than shipment by rail that the foreign product has been imported at a lower cost than that required for the delivery of the Utah minerals at the centers of consumption. This is the sole and sufficient explanation of the comparatively small demand for the Western hydro-carbons. Gilsonite (uintaite), however, is of a quality to command recognition even in the face of cheap importation of the inferior materials. The principal occurrences of this mineral in the Uintah Basin are as follows:

The Duchesne vein, located within three miles of Fort Duchesne. This is a nearly vertical vein, traceable by surface outcrop for about three miles on its strike, with an average width of one and one-half feet, reaching in places a breadth of from three to four feet.

The Culmer vein, averaging fourteen inches in thickness, has been prospected for a distance of over two miles on its strike.

The Seaboldt vein, parallel with the Culmer, and averages a foot in width. To these must be added:

The Bonanza and Cowboy group of claims, which are to be counted among the most important and promising of all the

deposits of unitaite in the region under description. The outcrops may be traced for miles, and the product is of the highest quality. The Bonanza vein attains a maximum width of ten feet, and on the Cowboy a breadth of eighteen feet has been observed. From this point of greatest width it maintains a breadth of ten to twelve feet for a distance of about three miles.

The Black Dragon vein shows a width of from eight to nine feet. This is located near Upper Evacuative Creek. The enclosing walls, which are practically vertical, are impregnated with the hydro-carbon deposits to a distance of from a foot to three feet from the vein proper.

The Utah Refining company and the Lubra Oils Manufacturing company, located with an extensive factory at North Salt Lake, provides a sure and constant market for all the oil products of the state, and is already actively and extensively engaged in manufacturing commercial products of various character from the raw material of adjoining states.

Their products are gasoline, kerosine oils, lubricating oils, transformer oils, waxes, candles, greases, high-fire test materials, paints, and is supplying the city gas company much material from which the illumination of homes is secured.

The company is equipped to take care of all oils, and is in every way encouraging the development of oil wells in the state of Utah.

Gilsonite (uintaite) and its hydro-carbon allies occur elsewhere in Utah. The former is profitably mined in Wasatch county, and bituminous limestone is produced in paying quantities in Utah county. The production of uintaite alone averages in amount from one to two thousand tons per year. It is profitably shipped to the railway by the otherwise light-going freight teams plying between Vernal and Price.

Demonstrated facts warrant the statement that the hydro-carbon deposits of Utah surpass in variety, purity and extent all other recorded occurrences. They outcrop in a manner conducive to cheap mining, and transportation facilities alone are lacking to make deposits a bonanza of wealth to the owners and a cheap source of valuable and most desirable material to the consumer.

Of the companies operating on the gilsonite and elaterite deposits the last biennial report of the state coal mine inspector remarks as follows:

DESCRIPTIVE LIST OF HYDRO-CARBON MINES.

The Gilson Asphaltum Company, located at the terminus of the Uintah Railway, in Uintah county, is the largest producer of gilsonite in the west.

The mine at Dragon, known as the Black Dragon, is working a true fissure vein of gilsonite, and is operated by a drift and two shafts, on a seven-foot vein. This mine employed an average of fifty-three men during the year and produced 15,916 tons of ore, at a cost of $7.15 per ton. A water system has been installed at this mine, which is a great benefit to the miners, as the vein being dry, very much dust is made while mining. Electric lights are used throughout the mine.

The Bonanza, operated by the same company, produced 1,161 tons of gilsonite, and is situated on White River.

The Norvill Mine is located on the same vein as the Black Dragon, about ten miles northwest of Dragon, and is owned bythe American Asphaltum Association of St. Louis, and is worked by lease, the ore being hauled by team to Dragon. This property is worked under the supervision of Max E. Smith, producing 4,135 tons of ore. The mine is worked by a cut in the vein, no lights being used.

The Raven Mining Company has been working a few men on a claim of gilsonite near Fort Duchesne; also an elaterite claim in Lundley Hollow, but as yet have no report from them for 1907.

The Pittsburg-Salt Lake Oil Company's mines, situated in Wasatch County, at Castle Peak, or Indian Hollow, have been shipping the product of their mines to Salt Lake, via Colton and Price. They mined 250 tons of gilsonite, employing forty men; 125 tons of Elaterite, and 100 tons of Tabbyite. These products were nearly all used in their own factory at Salt Lake City, where they manufacture paint, varnishes, rubber, oils, rubber fillings, and insulating compounds. The cost of these ores, f. o. b. cars at Colton and Price, was from $21 to $26 per ton.

West of the gilsonite fields some fifty miles are the elaterite (mineral rubber) deposits of Lake and Indian canyons.

Here the Raven Mining Company is operating on the narrower veins of this more valuable hydro-carbon. The production from these mines varies in different years but has amounted to 2,000 tons per year. The product brings a higher price than the gilsonite; selling for $65 per ton.

Along the divide between the Green River and the Great Salt Lake drainage basin, near Soldier Summit, there occurs valuable deposits of ozokerite, or mineral wax.

The latest report of J. E. Pettit, coal mine inspector for Utah, refers to two companies operating on this ozocerite as follows:

The National Ozocerite Company, situated two and half miles east of Colton, has extracted 1,565 tons of ore during the year. They have also erected a leaching plant for their ores; have also put in a pumping plant, by which water is pumped 6,820 feet from Colton River to the mine. Cost of improvements at the mine was $18,323.21. The refined product was shipped to New York.

The United States Osocerite Company, located at Midway, five miles east of Tucker, Utah County. This company has shipped no ores during the past year, but have installed an electric lighting and power plant, a milling plant and an aerial tramway, connecting mine with the leaching plant, at a cost of $5,000.

ASPHALT IN UTAH.

An interesting and also commercially promising occurrence of asphalt in Utah is found along the bed of the Great Salt Lake ten miles south of Rozel, on the Southern Pacific Railroad.

"The occurrence of this asphaltic substance appears, so far as now known, to be restricted to the shallow littoral portion of Great Salt Lake, one-fourth to 1 mile out from the present short line, immediately southeast of the Rozel Hills. It there exudes through the unconsolidated material on the bottom of the lake and bubbles up into the water in the form of hollow spherical or tubular masses 1 to 2 inches in length, and

of threads and hairs 6 to 18 inches in length. These small masses spot the bottom in great numbers throughout this area. At certain points the emissions are concentrated into considerable seepages or "pitch springs," 1 to 2 feet in diameter. The source of these seepages appears to those who have prospected this ground to be a bed of asphalt 2 or 3 feet thick, which was encountered 80 feet below the present lake bed, and an underlying series of asphaltic beds 3 to 5 feet thick, which alternate with beds of clay to a depth of 140 feet, at least. In the vicinity of these seepages the asphaltic matter cements the calcareous oolitic deposits of the lake bottom into a bituminous limestone. This forms numerous low islets, 1 to 50 feet in diameter, which are distributed in rough alignment. This alignment and the presence of intensely brecciated zones in the limestone on the mainland suggests the possibility that the seepages may be along zones of fracture. These may have served merely to open exits for the fluid asphalt in unconsolidated lake beds, or may have also delivered it from deeper reservoirs in underlying bed rock into its present position. In brief, the asphalt occurs either in bituminous oolitic limestone, as the cement, or in springs, as liquid asphalt from beds 3 to 5 feet thick, intercalated with clay beds at a depth of 80 to 140 feet.

In character this substance is opaque, brownish-black, oily, viscous, and strongly asphaltic in odor. Its consistency varies readily with the temperature, from a thin, semiliquid state at body temperatures to a rigid, brittle state in outdoor winter temperatures, which permits it to be chipped with a pick. The composition has been studied and numerous analyses have been published in current mining magazines, which show high percentages of asphalt and oil."—Boutwell Bulletin 260 U. S. G. S. p. 474.

BUILDING STONES.

The term "building stones" as used in trade and commerce is of wide application, including all materials of structural utility, such as stone used for building purposes generally, and materials for fences, monuments, bridges, etc. It is by common

usages in statistical reports intended to comprise clays, cement material and ornamental stones, exclusive of gems.

But few building stones in the world are utilized in their raw state for other than local application. Practically every section of our own country produces its local supply. However, material of particular excellence may be and is utilized beyond its limits of occurrence.

Utah is rich in structural materials of superior quality, and in abundance to meet all demands.

Granite in a general sense comprises not only the rock of that name, as classified by the lithologist, but many allied species such as diorite, diabase, syenite, gneiss, and even dolerite and gabbro.

The widely known occurrences of granitic rock in Little Cottonwood Canyon are of first importance. This rock is essentially a syenite, or more specifically a dioritoid granite. It has been designated as Temple Granite by the official geologists, in reference to the great Temple in Salt Lake City, which is constructed of this material. The rock constitutes the greater part of the colossal mountain mass, and its abundance is beyond computation or estimate.

Granite rocks of allied composition and similar quality occur in Beaver County and elsewhere to the south, while the gneiss of Farmington Canyon and the dioritoid rocks of Ogden Canyon and vicinity on the north are of great and growing importance.

Sandstones of special excellence occur in Salt Lake, Utah, and adjoining counties, and in smaller quantity in practically every county of the State. The bright colored sandstone of Red Butte Canyon, near Salt Lake City, and the gray Kyune sandstone from Spanish Fork Canyon, have been used in many of the most imposing buildings of the metropolis and other cities.

Limestone constitutes the main bulk of the Wasatch Mountains and other Utah ranges. The variety specifically known as Wasatch limestone is an excellent building material, and is used also as a flux in smelter processes. It is so rich in calcium carbonate as to be in demand for the production of car-

bonic acid gas in the sugar factories of the State. A variety of limestone occurring in San Pete County and elsewhere is oolitic—that is, composed of small globular particles resembling fish eggs, hence its name—oolite. Some of the most pretentious residences of Utah cities are constructed of this beautiful stone.

Marble, really a crystalline variety of limestone, is found in Cache, Box Elder, Salt Lake, Utah, and southern counties.

Utah Onyx, also a calcium carbonate, but of such beauty as to preclude its use as a building stone proper, and to insure its popularity as a material for interior decoration, is found in great quantity. Box Elder, Salt Lake and Utah counties are the principal producers. The elegant wainscot in the corridors of the City and County Building, Salt Lake City, is of Utah onyx from the Pelican Point deposits on the shores of Utah Lake.

Concretionary Marble, otherwise known as nodular limestone, occurs in quantity incalculable at the head of Hobble Creek Canyon, near Springville, Utah county. This rock is of surpassing beauty as a building material, being made up of concentric nodules, from the size of a pea to that of a walnut, firmly cemented together. It takes a superb polish and is in demand as an ornamental stone.

Slate of excellent quality is quarried in Slate Canyon, near Provo City. It promises to displace the time-honored shingles, so common in the West, as a roofing material.

LIMESTONE.

The important market for limestone in connection with the smelting industry of Utah along with the market for the burned lime for building purposes, makes the immense formations of our mountains seem more than mere crust-making rocks of the earth. Throughout the state pure limestones are found in abundance for burning and for fluxing purposes.

PHOSPHATE ROCK.

The discovery of extensive phosphate beds in the State has opened up a new and important industry in Utah. Although the home market for the raw or manufactured product of these beds of fertilizer is limited, there seems to be no reason why, with the favorable rates of transportation that the railroads can give, the market may not extend rapidly to Honolulu, Japan, and Australia, as well as to the Middle and Eastern States.

The phosphate series occurs within the Carboniferous rocks which outcrop over considerable areas in eastern, central, western, and northern Utah. They consist of alternating layers of black or brown phosphatic material, shale and hard blue and gray fossiliferous limestone. While the series is about 90 feet thick, the beds of phosphate material vary in thickness from a few inches to ten feet.

The main phosphate bed is five or six feet thick, oolitic in structure, and high in phosphoric acid, (P^2O^5). These beds have been the most fully prospected in Weber canyon, near Peterson and Croydon in the Wasatch mountains, where they outcrop along the sides of the canyon. They also appear in canyons several miles to the north.

Another occurrence near Woodruff, Utah, is largely concealed by heavy wash and therefore has not been fully prospected. It occurs as a bed five feet thick. In many other localities in the state phosphate material has been reported, but this industry is new in the west, and but little has been done to develop it.

FIRE CLAY.

(See Page 172, Am. Min. Cong., 1906.)

Utah is at present producing many kinds of refractory fire clay products, including fire brick, sewer pipe, drain tile, hollow partitions, assay crucibles, and muffles. The superiority of these products has developed an extensive market, until the present manufacturing establishments are scarcely able to supply the demand.

The fire clay deposits of the state are of excellent quality and many are of enormous size. The Utah Fire Clay Company controls extensive deposits in Utah county. The Western Clay Products Company is working deposits in Utah and Salt Lake counties. Other companies are operating on deposits of local importance over the state.

CEMENT.

The Utah Portland Cement Company has for many years done a flourishing business at its works in Salt Lake City. The cement rock is brought in from Parley's canyon, Salt Lake county. The Union Portland Cement Company of Ogden, Utah is now operating a 2,000-barrel plant near Croydon, Weber canyon, where it secures its calcareous shales and limestones for a very high grade cement. The plant is modern in every detail, and the Red Devil brand cement is being sent over the country for use in the many industries where cement construction has become so important. There is an abundance of rock formations over the state suitable for cement making as the country develops.

GYPSUM.

Immense deposits of rock gypsum occur in Utah, in the following counties: Juab, San Pete, Sevier, Millard, Wayne, Emery, Kane, Grand, Iron, and Washington. Those of Juab, San Pete, and Sevier are at present the ones being exploited.

The Nephi Plaster Company of Nephi, Utah, is operating on the Juab county deposits one mile east of Nephi. This gypsum bed is claimed to be the largest and purest natural deposit of gypsum ever discovered. The company has recently equipped it plant with the most modern machinery and is now producing the highest grade materials including finishing plaster, fibred and unfibred hardwall, casting and moulding plaster, dental plaster, and land and grain plaster.

The Robinson Plaster Company and the Jumbo Plaster

Company, operating on the deposits of Sanpete and Sevier counties, are putting out high grade materials from their extensive beds.

The market for this plaster material extends northward to Vancouver and Victoria, through the Pacific States, and throughout the intermountain region.

SULPHUR.

Native sulphur occurs in extensive deposits at Cove Creek, Millard county. The crude ore averages 20 per cent sulphur, although masses of pure sulphur are often encountered. The product from these mines is exceptionally free from arsenic and other deleterious substances. The beds are owned and operated by the Utah Sulphur Company, who have complete refining works at the mines. The production of recent years has been around 1000 tons per year. The products of the refinery are crude sulphur, obtained by melting the sulphur from the rock by means of steam; powdered sulphur; sublimed flours of sulphur, and roll brimstone.

At present the market extends over the intermountain states, Arkansas, Texas and California. The material finds use in sheep dipping, tree spraying, fruit and hop bleaching, and sugar refining.

VANADIUM, URANIUM, RADIUM, ETC.

These rare elements often occur together. The principal source of these minerals in the state is an extensive area in southeastern Utah. The vanadiferous minerals of Richardson, Utah, are the richest deposits of vanadium ores yet discovered in the United States. These are associated with carnotite, the scientifically interesting radio-active mineral from which the radium chloride, so much written of, is obtained.

Fort table use the salt is refined at the works. The process consists in crushing, drying and winnowing while hot. The efficiency of the fans is separating the efflorescent sulphates

from the crude salt is abundantly demonstrated by a comparison of the analyses of crude and refined products. The refined salt is ground and sifted to give products of the proper degree of fineness, as required for packing, table and dairy use. The salt so prepared is of exceptional purity, as the following analysis shows:

	Per Cent.
Sodium chloride (pure salt)	99.927
Calcium sulphate	.058
Insoluble matter	.007
Moisture	.008
Calcium	Trace
Magnesium	Trace
	100.00

The dense brine of the Great Salt Lake constitutes a vast mine of chemical riches, offering a vast variety of chemical products, other than salt, at the minimum cost of preparation. The total solid matter in solution in this water amounts to about 18 per cent, or more than five times that of sea water. The solid consists principally of sodium and magnesium salts. The chlorides and sulphates predominate.

Next to salt, sodium sulphate claims attention. This mineral, known as marabilite, crystalizes from the lake water in the winter, when the temperature reaches 20 to 30 degrees Fahrenheit. Hundreds of thousands of tons of this material are deposited in the lake bottom and are washed upon the shore whenever the temperature reaches the low point given. This sulphate is of importance in the manufacture of soda.

Manufactured Food Products

The dairy and food laws of the state cover a very large field, embracing the sanitary condition of all dairies, manufacturing plants of food products, hotels, restaurants, and all rooms thereof, and all other places where food is prepared, stored, or offered for sale. Also the taking of samples for analysis that impurities and adulterations may be detected, and also prosecutions for the violation of the above requirements.

DAIRYING.

The dairy products of the state are increasing continually, but not sufficiently to supply the demands of our increasing population. This is especially true as to the supply of butter and cheese, which we are importing from other states during the winter months, in quantities that equal the production in this state. A good deal of the scarcity of butter and cheese is due to the fact that the production of condensed milk is continually increasing. This, of course, makes a heavy demand for milk that heretofore was manufactured into butter and cheese. The demand for sweet milk and cream is continually increasing in the larger cities. This would also have a tendency to cut down the production of butter and cheese.

BUTTER.

It is estimated that Utah has produced in 1909, between five and six million pounds of butter, valued at about $1,800,000. It is estimated that this amount is nearly sufficient for our own consumption. In addition, about four million pounds of butter was imported into the state, while a like amount was exported to adjoining state. The location of Utah being in the center of the Rocky Mountain region, makes it a fine distributing point.

Some of our larger creameries are now shipping butter into Colorado, Nevada, California, Oregon, Idaho, Montana, and Wyoming. The demand from the above mentioned states varies with the different seasons of the year.

CHEESE.

The production of cheese in the state is very limited, not being sufficient to supply the demands. The estimated production in 1909 is between 1,500,000 and 2,000,000 pounds, valued at about $250,000, with an importation of about 1,000,000 pounds, which is required to supply the demands of the state.

CONDENSED MILK.

Cache Valley has two flourishing condensed milk factories, which are the only ones in the state at present. They are located at Logan and Richmond. There is another under construction at Smithfield, and prospect of still another being built at Wellsville. These factories, during 1909 produced about three hundred thousand cases of evaporated milk, valued at $1,200,000 of which three-fourths was exported. The milk is of a very excellent quality, and the demand is continually increasing, and should, within the next few years be at least doubled.

The value of our dairy products, including sweet milk and cream sold in the large cities of the state, is estimated at about $5,000,000, which is a very small amount, when taking into consideration the splendid facilities the state affords for dairying.

An abundant hay crop is raised in the state, most of which is alfalfa, which makes the best food that can be found for the production of milk; the price of which hay is so low that it can be fed to good cows with large returns.

The climate is especially adapted to dairying, the cool summer nights, and dry atmosphere, mountain streams, also mountain pastures and meadows—all of which are ideal conditions.

INSPECTING DAIRIES.

The dairies of the state have all been inspected and scored according to the government score-card system, which has been adopted by this department. We find the score card a great help in improving the sanitary conditions of the dairy, as it readily shows where improvements can be made.

Dairies are in a good sanitary condition, with but a few exceptions. A great deal of good could be accomplished if there were sufficient inspectors to visit every farmer in the state, that is selling milk to our creameries, or to the public, at least two or three times a year.

At present, in a good many cases, there is absolutely no care taken in the handling of milk on the farm. The milk is finding its way into our butter and cheese, and being used on our tables. By making these inspections, bad conditions could be remedied.

Utah is continually increasing in the manufacturing of various kinds of food products, of which there is a surplus above home consumption. The sugar industry is the leading one among them, turning out an excellent product.

The fruit canneries are also turning out an excellent quality of goods. The canneries have all been inspected for sanitary conditions, and in most cases were found in excellent condition.

The manufacturing of candy is continually growing, and an excellent quality is being turned out, and is finding its way into nearly every state of the union. The sanitary condition of these factories is satisfactory, and improvements are continually being made.

The pickle and vinegar industry is growing, and the climate is especially adapted for the raising of onions, cucumbers, cabbage, cauliflower, and other vegetables, used for this purpose. This may be said of the various manufacturing plants of food products in the state. They are all growing, and making improvements along sanitary lines.

The rules and regulations of the U. S. Department of Agriculture on food products has been the means of a great deal

of good for our state. Section 5, of the Pure Food laws makes the standard of quality, purity and strength for foods, liquors, and drinks the standards of purity, quality and strength for the State of Utah. This is as it should be, and such laws should be enacted that would conform with the Federal laws in every detail, that all manufacturers could ship their goods anywhere in the United States, without having to change their labels.

The laws of some of the adjoining states have made it impossible for some of the Utah goods to enter with the same labels that are accepted in this state. The commissioners of the state of Wyoming, and Idaho met with the Utah commissioner in November, with the object of becoming more familiar with each other's laws and regulations. This, it is believed, will shortly bring about a better understanding, and the difficulties heretofore encountered will be removed.

Fish and Game in Utah

In line with this great movement of Conservation, the fish industry of Utah should have special attention. In the past it has received but little if any consideration, for the reason that but little was known as to its benefits or profits. In the past three years some fifty or more private fish industries have been started in the state. Some are yielding good profits, and before the close of another year all will be revenue producers.

Last year the Legislature appropriated about $18,000, "the money collected by the department from the sale of licenses," for the erection of new hatcheries and the repairing of the old one at Murray.

Hatchery No. 1 at Murray, Salt Lake County, Utah, has been remodeled and now has a hatchery capacity of 2,000,000; Hatchery No. 2 at Spring Creek, Utah County, has just been completed with a capacity of 2,000,000, and two others will be built in the early spring in the southern part of the state.

The department is now assuming proportions that will in the near future make it one of the greatest revenue producers of the state, not only for the maintainance of itself but as a commercial industry for the people. We cannot afford to ignore any longer the fish and game interest, as the following table will show the number of trout hatched in the past nine month:

Eastern Brook Trout	750,000
Rainbow Trout	600,000
German Brown Trout	300,000
Native Trout	4,200,000
Total	5,750,000

While the above table shows that 5,750,000 trout fry was successfully hatched and planted in the different streams of the state, it is only a beginning, as in the year now before us we expect to hatch and plant not less than 10,000,000 trout fry. Thus our streams will be teaming with the beautiful speckled trout as they did in the early days.

FISH HATCHERY NO. 1, MURRAY, UTAH.

OPEN SEASON ALL YEAR.

The screening of our canals is the one important subject before us. The Fish and Game department is not producing enough revenue to do this work itself. The Legislature will be asked next year to make an appropriation for that specific purpose, or pass a law requiring every irrigation power and water company to properly screen its ditches and canals, and thus help to save thousands of our fish from perishing upon the meadows and fields.

Our state abounds with pure water. The rivers and lakes are the most desirable for fish culture. In passing we cannot help mentioning Utah lake, situated in Utah county. From the fish-interest standpoint this grand body of water has nothing superior in any of our inland states. It is full of the choicest of fish foods, and will in the near future produce the major portion of our game fish. This year by the protection given the bass not less than 10,000,000 were hatched in this lake. It is very noticeable in Cache, Box Elder, Weber and Utah counties, where bass are on the increase, that the carp are on the decrease.

It is the desire of the Fish and Game department, when the streams and lakes are properly stocked and hatcheries sufficient to keep up the supply which should be in the next three or four years, to have an open season the year round for fishing, for all kinds of game fish.

WILD GAME BIRDS.

The law passed by our last Legislature closing the season for four years for the hunting of game birds will materially increase them in our state, and with the importing of the Hungarian pheasant and other birds by the department this season, should presently make Utah a paradise for hunters, in the open season.

Some one has defined ornithology to be the study of birds from the standpoint of dollars and cents; and it matters not whether the birds be classed as a game-bird, a song-bird, or an

insectiverous bird, its value living far exceeds its value dead. Think of what this means to the state, and to you.

Consider the worth of fish and fishing or hunting—the pleasure, experience, recreation, with consequent better health and improved ability to meet all demands made. And in addition think of the cash value of the many tons of fish and game taken.

Our laws must as nearly as possible be drawn to meet the necessities of the entire state. The uniformity as near as possible of the state laws throughout this intermountain country would be a most excellent thing. Some amendments to our present law will be necessary, and probably will be made at the next session of the Legislature.

The all-important thing to do in our state is to give full protection to all the Fish and Game interests, as far as it is possible. And with the aid we are receiving from the people of the state at this time we are sure of success.

Extremes of Temperature, Precipitation and Wind.

MONTH.	Temperature.						Precipitation.			Wind.			
	Maximum.	Year.	Date.	Minimum.	Year.	Date.	24-hour maximum.	Year.	Date.	Maximum velocity.	Direction.	Year.	Date.
January	57	1900*	13	—20	1883	20	0.64	1906	19-20	48	se.	1879§	26
February	68	1879	27	—13	1884	13	1.32	1881	4	60	n.	1900	6
March	77	1879	30	9	1890	1	1.17	1874	30	60	nw.	1906	13
April	84	1889	27	18	1896	1	1.40	1882	6	60	sw.	1893	6
May	93	1887	31	25	1899	2	1.53	1908	25-26	56	w.	1899	29
June	101	1900	28	33	1898	3	2.00	1885	5	54	nw.	1901	6
July	102	1889	30	43	1902	3	0.77	1893	23	50	e.	1909	18
August	101	1875	6	44	1880†	3	1.04	1898	29-30	64	w.	1907	3
September	93	1875	6	32	1900‡	24	1.84	1886	1-2	44	e.	1896	19
October	86	1889	6	22	1878	26	1.01	1886	18-19	52	ne.	1906	21
November	74	1898	6	— 2	1896	29	1.56	1875	18	66	nw.	1906	15
December	61	1874¶	1	—10	1879	25	1.38	1888	14-15	50	nw.	1901	26

*also on the 25th, 1905; †also on the 31st, 1908; ‡also on the 27th, 1908; ¶ also on the 11th, 1906; § also from the south on the 5th, 1895.

BAROMETRIC PRESSURE.

Mean, 30.02 inches. Highest and date, 30.64 inches, on January 29th. Lowest and date, 29.43 inches, on July 5th.

TEMPERATURE.

Highest and date, 101°, on July 1st. Lowest and date, 4°, on December 18th.

Extreme yearly range, 97°.

Greatest monthly range and dates, 51°, from 95° on June 30th, to 44° on June 10th.

Greatest daily range and date, 35°, on September 11th.

Dates when 90° or above, June 3, 4, 26, 28, 29, 30; July 1, 2, 3, 5, 15, 16, 17, 24, 30, 31.

Dates when below zero, none. Dates when below 10°, January 10, 11.

PRECIPITATION.

Longest period without precipitation, 21 days, from October 8th to 28th, inclusive.

Longest period of rainy days and amount, 7 days, from February 7th to 13th, inclusive, 1.26 inches.

Dates of hail and sleet: hail, January 9; February 8, 17; March 4, 30; April 8; May, 10, 29. No sleet.

FROST AND SNOW DATA.

From January 1st to June 30th:

Last killing frost, May 1st. Last heavy frost, May 17th. Last light frost, May 30th.

Greatest depth of snow on ground, 6 inches, on February 8th.

Greatest snowfall in 24 hours, 5.5 inches, on February 8th.

From July 1st to December 31st:

First light frost, September 23rd. First heavy frost, September 13th.

First killing frost, October 31st.

Greatest depth of snow on ground, 5 inches, on December 12th.

Greatest snowfall in 24 hours, 5 inches, on December 12th.

GENERAL SUMMARY.

The marked feature of the weather this year was the excessive precipitation which averaged much above the normal amount. January, March and August were unusually wet; while April, June and October were drier than usual, but there was no period of drought during the entire year. The greatest precipitation in 24 hours was 0.79 inch on the 22d and 23d of May. Other heavy 24-hour precipitation were 0.76 inch on the 13th of February and on the 6th and 7th of March.

The temperature for the year as a whole averaged nearly normal. The first month of the year was the warmest January on record, its mean temperature being about 10° above the normal. On the other hand, the last month of the year was the coldest December on record, and its mean temperature in marked contrast to January was nearly 10° below normal. No other month exhibited such marked temperature variation from the normal.

TIMBER

FOREST NURSERY SITE, SALT LAKE COUNTY, UTAH.

FORESTS AND FOREST RESOURCES.

Utah has never been considered a lumber producing state in comparison with the great timbered areas of the Northwest, yet there is no other one natural resource with which the future development and prosperity of our state is so closely allied and is dependent upon, as the forests and forest-cover which extend in more or less degree along every mountain range in Utah.

This forest land embraces an area of 7,808,000 acres, and of this 7,436,000, or 95 per cent of the total, is included within National Forests. This is exclusive of the great grazing ranges which for the most part can be considered as forest cover.

The greatest and most prosperous nations, states, and cities have always been those whose resources have been greatest. Just so, the future prosperity of Utah, as well as of other states, will depend upon the lasting value and revenue which the natural resources of the state can be made to produce.

The principal resources connected with forest lands in Utah are timber, water, grasses and other forms of forage; and directly dependent upon and allied with the timber and water are the immense power, manufacturing, mining and agricultural industries, while the very life and health of the people of our cities, towns and communities are dependent upon the quantity and purity of the mountain streams.

The grasses and grazing lands are indispensible to the continuation and prosperity of the live stock business, which is one of the most important industries of the country.

In the development and operation of a project or an industry it is policy to profit by the experience of others who have had the same problems to meet, and the force of this, as applied to the conserving of our forests, can be readily appreciated when one considers the results obtained in Germany under careful and practicable use and regulation of the forests, on one hand, and the lawless and wasteful methods which

have prevailed in the United States on the other. The German forests are in better condition, and 15 per cent more timber can be safely marketed from them now than 75 years ago; while in this country we are taking from our forests each year, not counting the loss by fire, three and one-half times their yearly growth. We use 260 cubic feet per capita; Germany 37 cubic feet, and France, 25 cubic feet.

The condition of the forest lands in Utah is much more encouraging than in most states, since 95 per cent is under the management of the National Forests, or Forest Reserves, and with the advancement already made and the plans for reforestation now under way by this department, the future is decidedly bright, and the opportunity excellent for the industries dependent upon forest resources within the state.

STOCK RAISING AND GRAZING INDUSTRY.

But the spirit of the West seems to be "Show Us!" And one of the missions of this report is "To Show." In the particular case of the conservation of the forest lands of Utah through the administration of the National Forest service, it can be shown that range wars have absolutely ceased. If no other result had been accomplished, the elimination of this source of constant strife on the forests, with the attendant loss of life and property would go a long way to justify the policy of National Forests.

That the regulation of grazing on the National Forests is beneficial to the industry is now almost universally conceded, and the proper handling of stock, by keeping it off the ranges until the forage crop is fit for use, has resulted in the improvement of range conditions to a marked degree.

NUMBER OF STOCK ALLOWED TO GRAZE IN THE NATIONAL FORESTS IN UTAH DURING THE SEASONS OF 1908 AND 1909.

FOREST	CATTLE & HORSES ALLOWED		SHEEP ALLOWED	
	1908	1909	1908	1909
*Ashley		9,000		87,500
Cache	12,000	12,450	105,000	103,000
Dixie	7,000	15,000	2,200	3,000
Fillmore	6,000	14,000	38,000	48,000
Fishlake	9,500	12,500	40,000	55,000
La Sal	6,100	15,000	15,000	64,000
Manti	26,000	26,000	194,000	190,000
Nebo	9,900	17,550	3,120	6,120
Powell	11,000	11,000	62,500	67,000
Sevier	11,000	11,000	120,000	121,000
*Uinta	27,000	19,300	341,000	275,100
Wasatch	4,250	7,800	16,000	15,500
Totals	129,750	170,600	936,820	1,035,220

*Ashley Forest created July 1, 1908, from lands taken from the Uinta Forest, which accounts for no allowance in 1908 for Ashley Forest, and also the reason why the number of stock allowed to graze on the Uinta Forest in 1909 is less than allowed in 1908.

An additional way in which the forest service grazing administration has greatly benefited the livestock industry is in connection with the extermination of predatory animals, particularly coyotes, wolves, mountain lions and bears. It is the opinion of many wool growers throughout the west that 10 per cent of their flocks are killed annually by predatory animals, and the losses in cattle and horses also are large. To reduce and ultimately eliminate this loss, the forest service has spent many thousands of dollars in the employment of professional hunters, and in detailing forest rangers for the purpose of exterminating predatory animals.

FLOOD DAMAGE LESSENED.

The value of the forest as a conserver and regulator of stream flow is generally recognized. This is especially true

in Utah, where many of the national forests were created upon the petition of the people affected, in order to secure the regulation of grazing and protection from fire upon important water sheds, and thus check the immense damage being done by floods.

Two of the best examples of this are the Manti and Fillmore Forests. In the case of the former, as a result of unregulated grazing the water sheds were stripped and severe floods occurred annually early in the spring. These floods caused severe erosion and washing in some places, and in others considerable areas of agricultural land were deeply covered with material carried down from the mountains. The value of the streams for irrigation purposes was greatly decreased, owing to the fact that the melted snow in the mountains went off with a rush early in the spring, thus greatly shortening the irrigation season, and lessening the amount of late water available for that purpose.

It was practically impossible to make use of the water for domestic purposes, on account of the great amount of silt and impurities held in suspension, and the befouling of the water due to the existence of too many sheep upon the headwaters of the streams. Practically the same conditions existed upon the Fillmore National Forest.

Since the creation of the national forests, according to the testimony of the settlers, conditions have steadily improved. The Manti Forest was created in 1903, and since that time the number of stock has been greatly reduced, and better methods of handling brought about. One of the first acts in the administration of the forest was to totally exclude all stock from the forks of Manti canyon; and as a result the area is now well covered with vegetation. Since stock has been kept out of the forks of Manti canyon, no serious floods have occurred.

On the other hand, in the canyons immediately north, south and east, in which stock is improperly grazed, destructive floods have followed heavy rains. During August this past summer, a great amount of rain fell over the entire area of the Manti Forest, continuing intermittently during the whole month. At this time terrific floods, carrying with them

large quantities of mud and boulders, occurred in the canyons north, south and east of Manti canyon.

No conclusion seems possible other than that the immunity of Manti canyon from flood damage was to a very considerable extent due to the fact that the practical exclusion of stock had allowed the growth of a sufficient amount of vegetation to prevent the severe erosion which occurred in the neighboring canyons. As a direct result of the floods, damage was done amounting to approximately $30,000. In many places roads were totally destroyed, and the transportation problem on the Manti Forest became so serious that it was necessary for the forest service to contribute $1,000 to assist in repairing the roads in co-operation with the settlers and other forest users.

Is it not plain, therefore, that from an economic and practical point of view conservation of our forest resources is essential, and that a well-defined plan for the protection and perpetuation of our forests is necessary?

FOREST CONDITIONS, AND THE TIMBER SUPPLY OF UTAH.

In years past the damage from forest fires has been exceedingly great. While only in the southern and northeastern parts of the state have there been extensive forested areas. still through the high mountains there were once large tracts of splendid commercial forests. There are comparatively few localities which have not been visited by the destructive axe of the lumberman, and practically none of which have not been burned over at least once within the last forty years. We find traces of great fires which occurred before the coming of the pioneers, but these burned areas are of insignificant size as compared with those of the past forty years, which are the result of careless burning by the settlers.

The towns and ranches in Utah's populous valleys have been built almost exclusively from timber secured from the adjacent mountains. Until the advent of the National Forests —or as they were first called, Forest Reserves—the majority

of the people seemed to have little thought of the exhaustion of the local timber supply, or of the ruinous effects which inevitably follow the denudation of mountain slopes. Every summer brought its fierce forest fires in the mountains, which burned on undisturbed until extinguished by the fall rains. A great many fires started in the slash resulting from logging operations. Fed by this debris, they raged unchecked, and killed all vegetation on such tracts, thus precluding the possibility of natural reproduction. As a rule, on such tracts a heavy growth of brush has come in. Since the establishment of the National Forests, destruction by fire has been reduced to an almost negligible quantity, through the system of ranger patrol.

RESTORE FORESTED CONDITIONS.

It is the object of the Forest Service to eventually bring these one-time forested lands back to their primeval forested condition, and then to manage them so that for all time they will yield timber to supply local demands, and at the same time exert all the indirect benefits accruing from the presence of forest cover. In the sale of timber the live trees are marked for cutting according to sound silvicultural principles, and every effort is made to encourage natural reproduction.

It is planned to conduct very extensive planting operations in this state during the next few years. A forest nursery, where seedlings of the principal forest trees of the region are grown, is located on the Wasatch National Forest near Salt Lake City. This nursery has an annual capacity of 4,000,000 seedlings. Forty thousand seedlings were taken from it this spring, and planted on Utah Forests. The majority of the planting was done on the Wasatch National Forest. This fall and next spring several thousand pounds of tree seed will be planted by broadcasting on National Forests throughout the State. The planting work is still to a large extent in an experimental stage. As soon as definite knowledge is gained, through the many experiments, as to the conditions under which planting operations may be carried on successfully, the reforesting of denuded forest lands will be undertaken on

a large scale. For many years to come the planting should be done on areas which once contained forest cover, rather than on those which have never been forested. Detailed planting plans have been prepared for several Utah Forests covering periods of several years. Work under these plans will in most cases be started next spring.

The principal tree species occurring in the northern part of the state are Engelmann Spruce, Douglas Fir, Lodgepole Pine, and Alpine Fir. In the central part of the state, Lodgepole is not found, but White Fir is added to the list. On the forests in southern Utah the chief species is Western Yellow

PINE FOREST DAMAGED BY FIRE.

Pine. This tree forms extensive forests, and is accompanied usually by a small percentage of Douglas Fir. The following table shows for each National Forest in Utah—

First: An Estimate of the living merchantable timber;

Second: An estimate of the merchantable dead timber standing and down;

Third: The maximum amount which it has been decided, after a careful study of conditions, should be cut during the fiscal year 1909-1910; and

Fourth: The actual cut in sales and free use in board feet during the fiscal year 1907-1908.

FOREST	Estimate Living M. ft. B. M.	Estimate Dead M. ft. B. M.	Limitation of Cut 1909-1910 M. ft. B. M.	Amount Cut 1907-1908 M. ft. B. M.	
				Sales	Free Use
Ashley	1,776,963	21,817	7,000	761	856
Cache	52,000			2,273	3,500
Dixie	165,000		2,000		219
Fillmore	925,000		4,000	1,340	5,520
Fishlake	180,000	21,000	1,000		124
La Sal	167,000		500		121
Manti	113,490	31,620	2,000	377	1,111
Nebo	45,100	15,063	250	82	48
Powell	1,100,000		10,000		410
Sevier	972,420	21,512	6,000		786
Uinta	1,666,000		10,000	3,939	2,361
Wasatch	17,480	1,450	*		4

*Sales dead timber, no limit.

This stand of more than seven billion feet of timber is worth from $10,000,000 to $15,000,000.

This is in addition to the value of the large areas of burned timber and of Juniper and Pinon, which serve an exceedingly important and useful purpose by providing the adjacent settlements with fuel, posts, and poles. Under scientific management, and with protection from fire, the condition of the forest area of the state should steadily improve, notwithstanding the heavy demands that will necessarily be made upon it in connection with all the lines of development that are being and will be carried on in the future. These demands will be enormously increased through the construction of railroads tap-

DEPLEATED FOREST COVER. RESULT OF BURNING AND SHEEP GRAZING. A SLOPE THAT CAN BE PLANTED.

ping the great undeveloped natural resources in and about the Ashley, Uinta, Sevier, and Powell National Forests. These forests contain the bulk of the timber in the State, and when once their resources are unlocked, through proper transportation facilities, Utah will have no further need of drawing on the Pacific coast for her lumber supplies, as she is compelled to do at the present time.

Fire Statistics for 1908, National Forests in Utah.

MANTI: $2.85 spent in fighting fires on public domain which threatened the Forest.

NEBO: Ten acres of land burned over. No timber destroyed or money expended fighting fire.

WASATCH: 140 acres burned over; $7,000 worth of timber destroyed; cost of fighting fire, $12.50 for range labor; $2.50 for supplies; Total, $15.00.

There were no fires on any of the other National Forests in Utah.

STATEMENT OF RECEIPTS FROM NATIONAL FOREST PRODUCTS. FISCAL YEAR JULY 1, 1908, TO JUNE 30, 1909.

Utah.	Timber Sale	Timber Set	Timber Fees.	Grazing	Grazing Fees.	Special Use	Total	Refund	Net Total	25 per cent.
*Ashley . .	1,311.42		54.73	6,107.49		11.94	7,485.58	**304.95	7,180.63	1,795.16
*Cache . . .	1,144.31		17.58	5,076.54	9.27	11.97	6,259.67	327.30	5,932.37	1,483.09
*Dixie . . .	213.78			1,193.01		15.08	1,421.87	3.42	1,418.45	354.61
Fillmore .	1,290.12		10.00	7,631.80		2.50	8,934.42	53.50	8,880.92	2,220.23
Fishlake .	2,484.50		4.42	9,565.74		57.57	12,112.23		12,112.23	3,028.06
*LaSal . .	526.61	55.54		8,057.03		2.80	9,055.33	2.81	9,052.52	2,263.13
Manti	5,517.87	468.89	48.00	21,810.89	10.00	27.00	27,469.30	524.66	26,944.64	6,736.16
*Minidoka	238.08		3.78	1,428.36		3.53	1,673.75	29.87	1,643.88	410.97
Nebo . . .	72.05			4,821.90	50.00	10.00	4,953.95		4,953.95	1,238.49
*Pocatello	16.54		3.45	227.25	4.67	1.50	253.41		253.41	63.35
Powell . .	872.50			7,463.23		38.50	8,374.23		8,374.23	2,093.56
Sevier . .	1,266.80			11,428.27		36.40	12,731.47	29.00	12,702.47	3,175.62
Uinta . . .	4,177.77		39.37	27,408.32	35.40		31,660.86	***1,840.15	29,820.71	7,455.18
Wasatch .	594.29		2.50	2,848.90	3.00	447.80	3,896.49	3.75	3,892.74	973.18
Total Utah	19,726.64	524.43	183.83	115,068.73	112.34	666.59	136,282.56	3,119.40	133,163.15	33,290.79

* Partly in another State. Receipts prorated according to area.
** Includes $300.97 to be paid to Uinta Indians.
*** Includes $782.50 to be paid to Uinta Indians.

WOOD PULP SUPPLY.

It has been reported to the Commission that there are large quantities of timber in the mountains in the eastern part of the State suitable for the manufacture of paper. The time fixed for the publication of this preliminary report would not permit of an investigation of this subject for this report. It is the purpose of the Commission to make a full investigation of this subject, and make as full a report as the facts will justify.